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The Magazine of New Energy Science and Technology

New Energy • New Science • New Technology

Volume 9 • Issue 53 • 2004

SOLAR POWER

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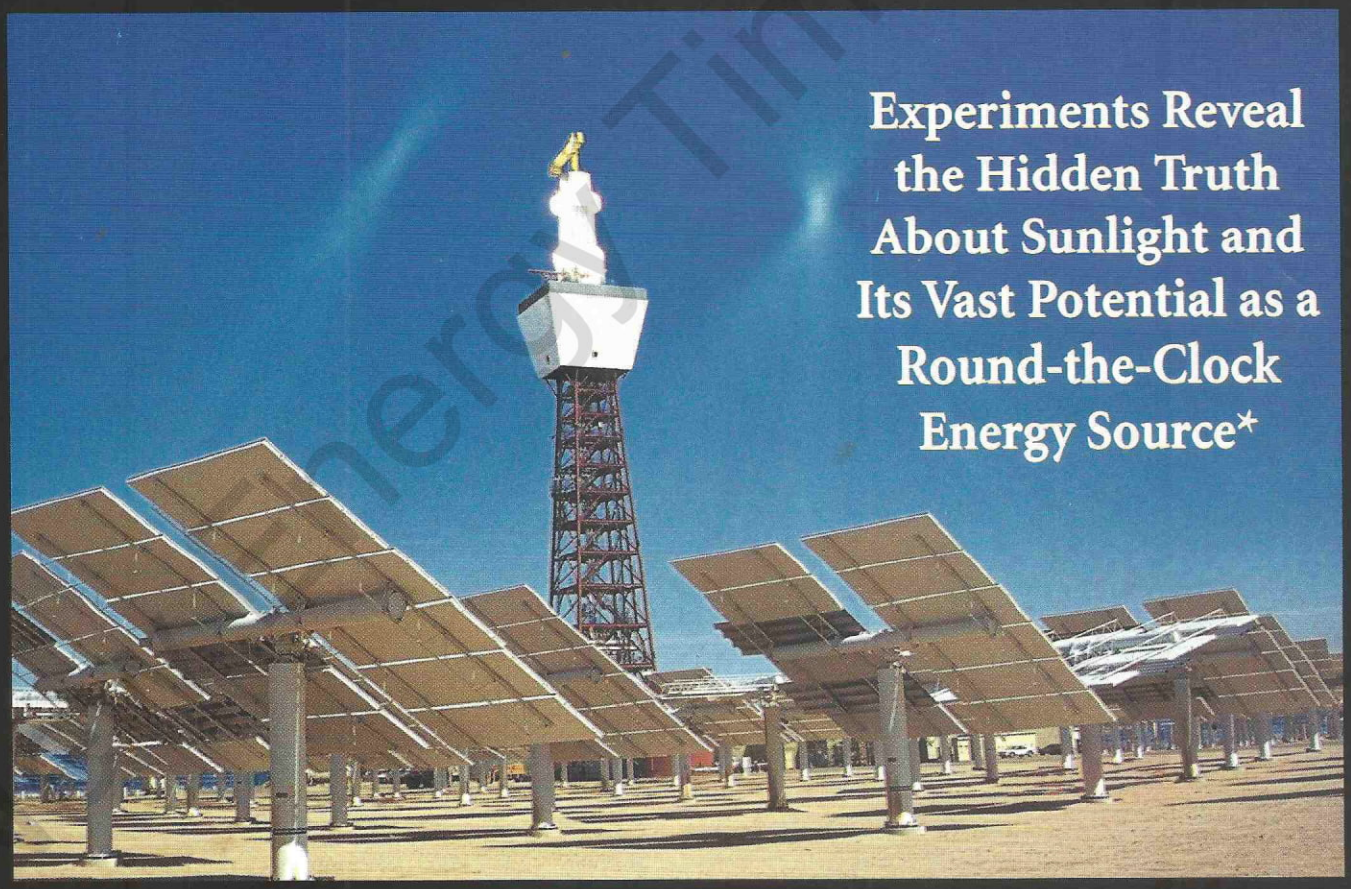

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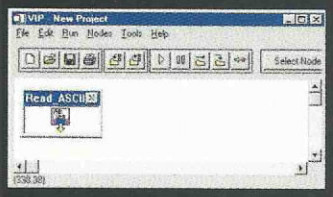

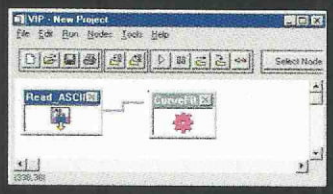

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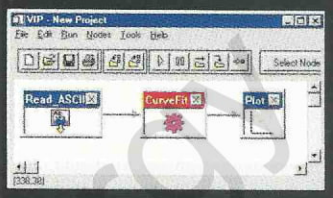

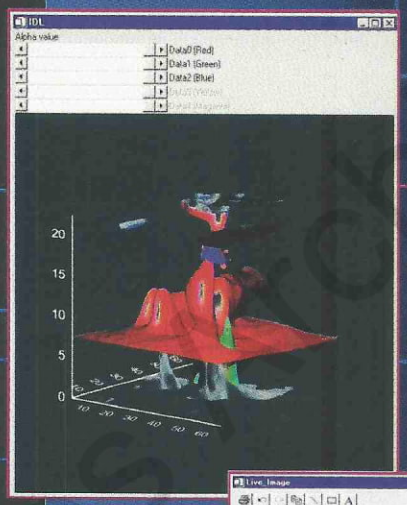

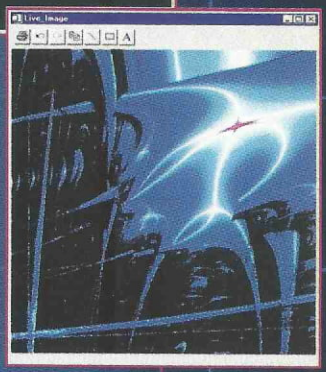

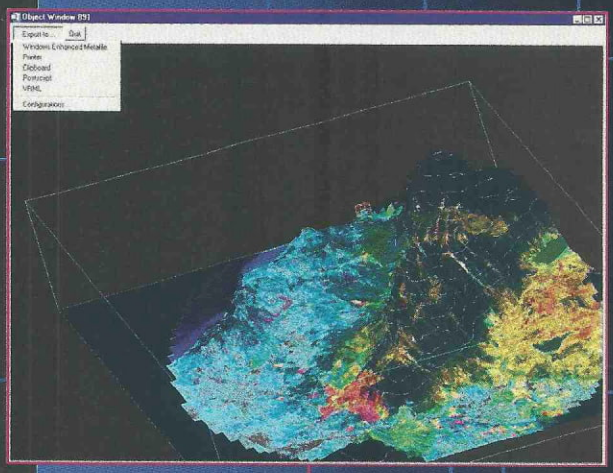

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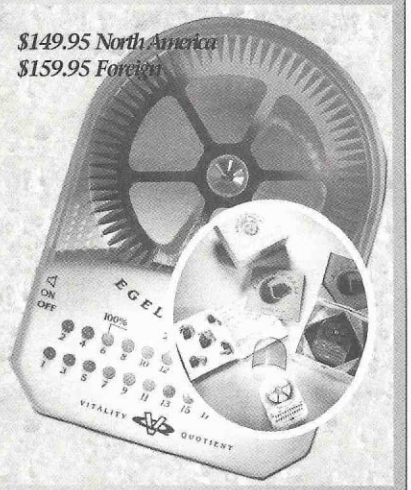

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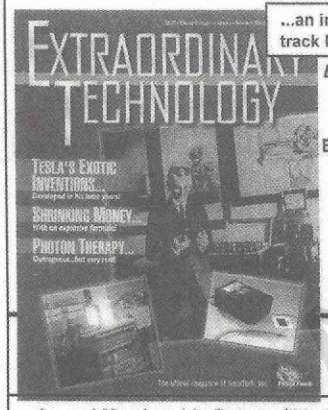

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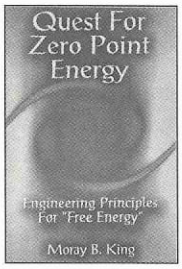

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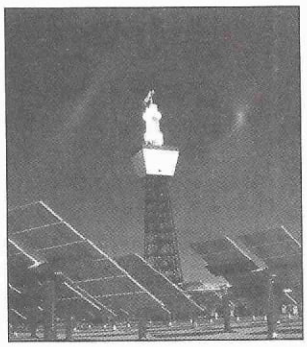
The Magazine of New Energy Science and Technology

The "New" Solar Power



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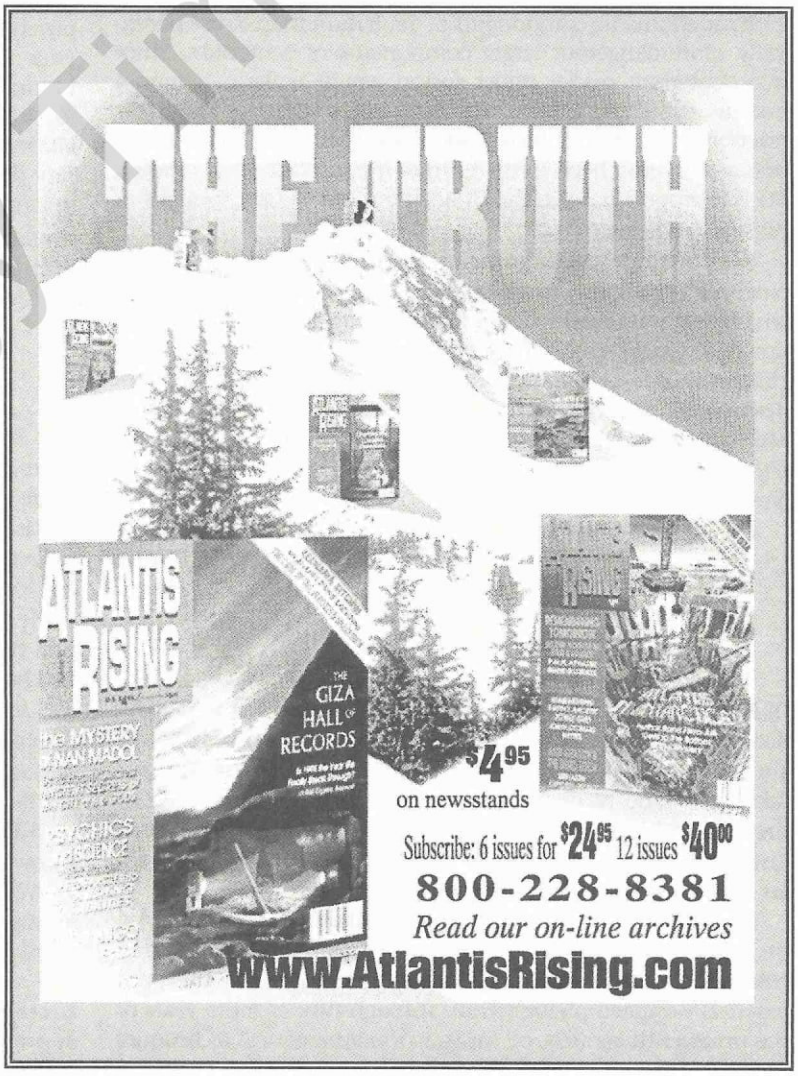

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LETTERS TO THE EDITOR

Rotating Nuclei May Explain Papp Engine

IE #51, about Joseph Papp's noble gas engine, may be considered as another example of how rotating nuclear ground states may qualitatively explain an unusual new energy phenomenon—in this case, how Joseph Papp's engines might work. They may be used to explain where the energy comes from (both during normal use and in the case of a large explosion), how energy may be gently given off without the "typical" nuclear signatures, and where the energy could temporarily go to during normal use of the noble gas engine.

As Papp apparently kept the exact composition of his fuel(s) a secret, a speculative comment may first need to be made. There may have been a large component of deuterium gas that Mr. Papp intentionally neglected to specify for his noble gas engine. See p. 28 of *IE* #51 where in that case it is stated ". . .approximately 36% helium, approximately 26% neon, approximately 17% argon, approximately 13% krypton, and approximately 8% xenon by volume." With average ratios of roughly 1.5 by volume between the lighter noble gas and the next heavier noble gas, he intentionally may have neglected to write at least twice that ratio of 1.5 or rather at least 3.0 being the ratio of deuterium gas to helium by volume. It might be safer to experiment with much smaller components of deuterium than to use potentially more dangerous larger components of deuterium. Since two deuterium nuclei under fusion would make a helium-4 nucleus, this could explain why Papp made reference to nuclear reactions. He may not have understood that some nuclear reactions could have been in the form of the interaction of rotating nuclear ground states rather than the more usually thought of nuclear reactions.

Two rotating nuclear ground states of deuterium could combine to form a highly rotating nuclear ground state of helium-4, which as it rotationally decays to a normal ground state of helium-4, it would give off much heat (energy) as the rotating charges increase the energy of background photons. For more discussion, see my paper "Some Thoughts on a Simple Mechanism for the $^2H + ^2H \rightarrow ^4He$ Cold Fusion Reaction" (*Fusion Technology*, American Nuclear Society, Vol. 24, No. 3, November 1993, pp. 319-323).

Alden Park
Ridgecrest, California

Proell-Rauen Effect

In *IE* #52, which contained Ken Rauen's article about the Proell-Rauen effect, I wish there was just a bit more info on Mr. Proell. You leave him pretty mysterious while also saying he was pioneering, a kind of discord. If the latter is true, it would seem there needs to be a little bit more description of his role, if even just a paragraph. You also refer to him as still around, and readers have to wonder what he thinks of Mr. Rauen's work.

The introductory text *The Versatile Soliton* (Filipov, 2000) on the nonlinear dynamics of soliton wave motion recounts the colorful history in which theoretical physics denied the even practically-applied phenomenon through fifty or more years of the nineteenth century, all for lack of mathematical techniques to easily analyze nonlinear phenomena. The failure of thermodynamics to analyze all the possible cases reminds us of this. The interesting effect is that eventually physicists did study solitons, providing a case for how their minds change. In this case, it was advances in theoretical techniques which having first been developed, then made physicists comfortable with analyzing new things. You can have all the anomalies you want, but without any theories to extend to explain them, physicists can say its just a matter for inventors to see what they can make, there's nothing science can do with it. The present context is one in which so much science has been done that engineering works much more forward from established science than it did in the nineteenth century, when lots of practical applications of new phenomena could be developed before science explained them. And in practice with say, electric power, Tesla's successful AC power systems were not really possible until he brought a theoretical analysis to the problems.

One thing which might impress academics more with the thermodynamics problems is some computer simulations of the effects at the molecular level. Isn't that sort of thing routine now? Statistical mechanics equations can be checked in detail with monte carlo computations to reveal slip ups in purely abstract derivations. An example of this showed up in your own magazine with some old articles on a peculiar Marinov electric motor, subsequently disposed of in your lab. A friend had pointed out to me that three-dimensional simulation computer programs were routinely used to design military devices such as rail guns, tracing all current flows within materials, and that such tools would have immediately revealed the omissions in the speculations published about that motor. That experience might give insight into how physics has made mistakes in thermodynamics.

George Lyons
Raleigh, North Carolina

The Editor Replies: Perhaps it was an oversight not to include more information about Wayne Proell. Maybe we will have some more about him down the road. However, we did note precisely where the idea came from and gave his address so folks could write to him and order his books; he used to have ads for them in *IE*.

He had no role in the research other than his book's description of the concept. He did not even know that his prediction had been confirmed until a few years after we had done it—this was so that the patent applications could be properly filed by Cool Engines, Inc. on intellectual property that went far beyond that effect. There was every intention to tell him of the experimental confirmation—and, in fact, he *was* ultimately told.

Wayne Proell thinks that Ken Rauen's work is marvelous. Below are excerpts from one letter that he sent to Ken.

We had thought of doing CFD (computational fluid dynamic) simulations, but the costs a consultant quoted us were prohibitive. —*EFM*

Excerpts from Wayne Proell Letter to Ken Rauen: I sure appreciated your March 25 [2003] letter—believe me, it

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sure was good news, more so than you may ever think. I have waited a long, long time to find out if a completely independent, qualified thermodynamicist would do more than say "interesting" about my publications, and I truly wanted to hear those golden words "it works" before I leave the scene. Since many better scientists than I have had similar experiences (*e.g., cf.* Michael Polanyi, the chemist, in his book *Logic of Liberty*), I have not felt bitter, but rather satisfied to have kicked off a new paradigm in science. Once you manage to distribute a couple hundred hardcover books, the knowledge therein will not disappear—though it has taken twenty odd years to welcome your own experimental and theoretical findings!

But more than giving me happy feelings, your work is the trigger that allows me several actions behind the scenes that both will assist you and other friends in this energy field. I am sure you have felt discouragement at times in this whole field of "new energy"—*e.g.* cold fusion, audio fusion, etc.—the exciting but discouraging mix of off-the-trail good ideas from some workers, and self-preserving promotion by others that give a bad name to really interesting potentials. Your experimental work should give quite a boost to *Infinite Energy* as showing there is real gold in that ore. When your scientific paper appears, you will be famous—while my books offer the theory, you will be the scientist who first made a laboratory device that reduced theory to practice, as the patent office says. I believe this fame will be prompt, because the device you made is quite simple, meaning accurate critiquing is possible, unlike another case involving internal combustion engines I shall mention to you.

Before getting down to actions that may help you, I add my sincere thanks for the credits you have given me in your paper, and especially naming the theory the "Proell Effect." You shall have more fame than I, but the transcension of the Second Law will allow credit for both of us, as well as fame for others in the future of this tremendous field.

You have, in an organization led by Dr. Gene Mallove, built up a background of approaches and experiment that has given a working device. Theoretically, the device or variants thereof can do what I describe as "separate hot molecules from cold ones" in the kinetic mix of molecules in any gas. While my book shows that theoretically the process can deliver cold gas as low as 50 degrees or so colder than ambient, your present prototype achieves a modest fraction of this. I can digress with suggestions here, such as minimizing wall losses by rapid cycling or use of pressurized gas, but that is not the point. You have a device which is simple, low cost in present form to manufacture, which exhibits an easily measured paradox of tremendous concern to the educational establishment—colleges, high schools, independent labs. The extent of cooling is not the point: you have a new effect.

I have some tenuous but long-term contacts in the heat engine business and have taken the liberty of writing formal letters promoting you personally. The first of these was to the Cummins Engine Company of Columbus, Indiana, a company rated very highly by *Forbes*, and one I know well. Bearing in mind the constraints you asked about publicizing your work, I have told them you have opened a new thermodynamic field via proof of transcension of the Second Law. I have specifically recommended that, while you may not be available, they offer you a position with Cummins and consider setting up a SuperCarnot project in addition. I have no great influence with Cummins, but have based my letter on your work being a very good deal for Cummins.

It will also add to my network I am building to tell you something you do not know. Several years ago, a friend, Mr. Irv Wait, a mechanical BS engineer of modest independent means, decided my Otto cycle transfer engine designs would work. His son, also an ME, works at a Cummins subsidiary in Seymour, Indiana. Wait progressed from models to mock-ups to transfer Otto engine prototypes and last summer demonstrated, both on engine stands and on road tests using a small tractor, that substantial improvements in efficiency (miles per gallon) were achieved by the transfer principle. Now, building auto or truck engine prototypes is quite expensive, so Wait has presented a proposal to Cummins for a venture project to be funded by Cummins. The point is, the fact that Wait also references my theories and has demonstrated the work per my book *High Efficiency Internal Combustion Engines*, also supports your own work, which is an entirely different embodiment.

This should bolster your own confidence in your work. Cummins is also likely to have their consideration bolstered.

I hope you can dodge the brickbats from the establishment, as I have had to do (actually mostly indifference), but the game is exciting beyond belief—worth it. Before I forget, I remember our several discussions in 2000 very well and am surprised you continued work in this field: you seemed pretty skeptical at the time! Makes me especially glad to have you aboard this scientific venture.

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Errata

In the Issue 52 article, "Review of the Tenth International Conference on Cold Fusion (ICCF10)," the website URL for Ludwik Kowalski was wrong. The correct address is:

http://blake.montclair.edu/~kowalskil/index.html

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BREAKING THROUGH

The "New" Solar Power

by Eugene F. Mallove, Sc.D.

In the fast-moving, technologically gimmicky world of the early twenty-first century there are many things that are new "under the Sun." But there is also something very old coming *from* the Sun, which can now be seen in a new light—pardon the pun. For the very first time perhaps, we may be beginning to see the Sun's radiation in its *true* light, and very tangibly so. This is the evidence: experiments which demonstrate the capture of solar power around-the-clock, solar power by day *and* solar power by night. No, the world hasn't stopped turning on its axis, so how can that be? Solar power captured at nighttime too? Yes—evidently extracted from unsuspected stores of energy, which are charged up by solar radiation, but certainly not in ways that modern physics has understood. This is a kind of widely available *latent heat* which is probably being observed, in part or in whole, in other types of excess energy *new* energy experiments as well. One thinks in particular of those carried out with atmospheric-arc or water-arc discharges, by Peter and Neal Graneau and their colleagues. But the energy release mechanism may well play a role in electrochemical "cold fusion" experiments as well, giving rise not only to some of the excess heat but to nuclear changes as well.

This "new" solar power should be of much more than passing interest to the conventional solar power industry with its focus on photovoltaic cells and thermal conversion solar power collection. There is simply no *conventional* way in which solar energy can be captured around-the-clock (with the exception perhaps of chancy wind power, in particular locations). As an example, the now defunct Federally-supported "Solar Two" experimental installation, a beautiful image of which appears on the cover of this issue of *Infinite Energy*, employs some 2,000 planar mirrors to actively track the Sun and focus sunlight on the central power tower. Within the glowing cylinder atop the tower, molten salts are heated and begin the first stage of heat transfer toward steam production and then electric power generation. Yet this array is as good as derelict junk during the nighttime. Ditto for every photovoltaic array and every other solar thermal installation worldwide; there is no energy capture at night.

In this issue, an article appears to which this editor has contributed, with Dr. Paulo and Alexandra Correa as lead authors and investigators, "Power Performance of Stirling Motors Driven from Modified Orgone Accumulators" (p. 9). It discusses the mechanical calibration of the power output of precision Stirling engines, whose working fluid is air—external heat source engines which have been known since 1816. The paper aims at determining the internal thermal power evolution characteristics of certain contiguous metal Faraday cages that are covered with several alternating dielectric and steel-wool layers—the so-called "orgone accumulators" (ORACs) first investigated by Wilhelm Reich in the 1940s.

Of course, conventional physics considers it *a priori* preposterous that such an enclosed plenum could manifest any sort of *new* energy, from within. Yet for over sixty years there has been significant evidence of thermal anomalies associated with Faraday cages, a phenomenon that Reich brought to Albert Einstein's attention in early 1941, but with long-term consequences unfortunately resembling roughly those attending the "cold fusion" announcement of 1989.[1,2] The metal Faraday cage at the core, with or without its exterior coatings, could never be expected by conventional understanding to evidence any unusual energy *draw* from without or energy *generation* from within. The only energy that would be available to such an enclosure, modern physics claims, would have to be derived from electromagnetic radiation from the environment—sourced directly or indirectly from the Sun. (RF radiation from artificial terrestrial sources having been definitively ruled out as explanations of the thermal effects discussed—by orders of magnitude and by direct measurement with RF meters).

Now the particular experiment in the paper in this issue of *IE* gives some indication already of the potential for around-the-clock operation of the MM6 Stirling engine (from American Stirling Corp.) sitting atop a modified orgone accumulator (see construction and other details in References 3 and 4). The "hybrid ORAC" (HYBORAC), with its Stirling motor, started running during daylight hours in Toronto, Canada on May 19, 2003 and ran some 20.5 hours (until 4:00 a.m.). It output (against friction) a daytime mean power of 125 mW and a nighttime mean power of 25 mW. Given the tiny calculated average Carnot efficiency (near 4.3%) of such a Stirling motor under the experimental temperature conditions, there had to be provided at the Stirling engine hot plate a mean of *at least* 1.75 watts of continuous sensible thermal flux (probably much more thermal flux, since the engine was probably far from Carnot efficient in its operation). The real shocker is that this kind of average minimum power evolved from within the HYBORAC's Faraday cage—1.75 watts—is on the order of or greater than 100 times the sensible thermal flux that the kinetic theory of heat specifies could have transited through that 8-inch metal cube under these conditions!

With a design improvement made by the Correas to the HYBORAC/Stirling (proprietary to them, but *not* increasing the frontal area exposed to the Sun), they were able to run the Stirling from solar environmental energy—uninterrupted for 48 hours, *i.e.* over two night cycles (June 15-16, 2003).

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They have reported this in Reference 5, which is already available on their website. Nothing would have precluded continuous operation for many more days. This really is *around-the-clock free power*. In the Reference 5 work, the Correas went beyond mechanical calibrations in their assessment of the Stirling performance: they employed electrical resistance heater activation of the the MM6 engine to prove that *two watts* of average power had to be applied to the hot plate of the engine for the mean around-the-clock engine speed of 123 rpm to be achieved! The corresponding kinetic theory of heat prediction would be a mere 8 to 10 milliwatts of thermal influx into the Faraday cage.

Now let us consider the implications of these results, first in terms of technological directions that might be taken in the field of solar power, and second, in terms of the new physics that is evidently required to explain such anomalous results. Our paper in this issue of *Infinite Energy* suggests that in the May 19, 2003 experiment, the Stirling engine puts out at least 200% more work-equivalent energy than typical photovoltaics (with equivalent area) output in the form of electric energy during an equivalent day. The implication is not that this particular Stirling-HYBORAC combination is better already today, in a utilitarian sense, than the electricity-producing photovoltaic array, but that there is the *potential* for using ORAC/Stirling designs (or perhaps modified ORACS with advanced types of solid-state converters) to capture much more solar-sourced energy than PV arrays.

The testing of June 15-16, 2003 with the incrementally improved-design HYBORAC/Stirling[5] already shows substantial gains in performance. The Correas conclude that the assembly put out between 2.75x and 3.15x more power during the 48-hour test than a photovoltaic array of equivalent area. During peak diurnal solar activity when the MM6 Stirling hit angular speeds greater than 160 rpm, the performance reached 5.5x photovoltaic performance. They state that they have also demonstrated efficiencies 150% greater than passive solar energy capture techniques.

Driving Stirling heat engines with solar power is nothing new; this was done as far back as the 1930s, but not of course around-the-clock and not employing ORAC technology. From my perspective, however, the most important implication of this new work is its proof that even such a supposedly secure area of physics as blackbody radiation theory and electromagnetism is almost certainly deeply flawed at its roots. How else can it be explained that a metallic enclosure can develop within it far more power than the ambient supposed electromagnetic radiation field would allow? The very nature of light is at issue, as it has been for hundreds of years. We recall the crisis about the spectrum of blackbody radiation as the twentieth century dawned, when Max Planck's energy quantization "fix" was put in to make the high frequency light "ultraviolet catastrophe" disappear. Well, the twentieth century's proclaimed success with the wave-particle duality concept within quantum mechanics, which followed from the Planckian fix, turns out to be superficial at best. The amalgamated concept of waves and photon energy packets crossing space will not pass muster and the final theory of light is almost certainly *not* as given in late-twentieth century texts.[6]

Conventional theory takes the Sun as the equivalent of a nearly ideal blackbody radiator with an absolute temperature at its luminous emission surface of about 5,750 K—though the higher reaches of its coronal atmosphere are on the order of 1,000,000 K (another unresolved mystery about the Sun, by the way).[7] It is from this orb of high temperature plasma material (at roughly 5,750 K) that supposed spectrum of electromagnetic radiation crosses a local patch of space-time—disembodied electric and magnetic field vectors of such EM radiation oscillating furiously as transverse waves. Upon reaching our planet, the EM radiation is partially reflected and partially absorbed by the constituents of the atmosphere. Such a tidy picture has been explored and explained with much confidence by so many texts.[7] How can there be anything fundamentally wrong with it? Easy! That is like asking, "How there can be anything fundamentally wrong with twentieth century models of atomic structure?" Yet a look at the large body of work in new hydrogen physics energy (www.lenr-canr.org and www.blacklightpower.com) is testament that these very fundamental accepted structures are nearly certain to be very flawed approximations.

My colleagues, the Correas, believe that for their part they have developed firm experimental evidence, which they have linked with their quantitative AToS theory (Aetherometric Theory of Synchronicity), that the Sun in fact radiates longitudinal Tesla-waves, another term for which is "ambipolar mass-free radiation," which are not limited to speed c. Their work with Tesla induction coils and Faraday cages, among other devices, suggests that what emanates from Tesla coils is not electromagnetic radiation at all. Moreover, what does come from such coils has been shown by them in various published monographs to produce within Faraday cages heating effects and lumination phenomena inside cage-enclosed vacuum tubes. These effects are indicative, they say, of how the Sun's basic emanation—energetic Tesla waves—interact with the stratified terrestrial atmosphere, and in turn with the Faraday cages that are the subject of the present HYBORAC/Stirling work. These atmosphere-attenuated waves from the Sun actually appear to penetrate the metal cages. Furthermore, there is strong reason to believe that molecular "atmospheres" of mass-free energy are transduced from a latent heat form within Faraday cages and the resultant sensible heat produced drives the affixed Stirling engine in the experiments. Without recasting electrons and other supposed "point-like" particles as extended aether energy structures, such as twisting and spinning toroids, it would be difficult to understand where these new energy storage modes might reside, so the Correa theory encompasses such changes too.

That is but a rough picture of what they have theorized, but the theory makes predictions with highly quantitative results that have many important implications not only for atmospheric physics but for cosmology as well. They have re-cast blackbody radiation theory with an underlying frequency spectrum of aether energy waves that gives rise to what blackbody theory only incompletely suggests.[8] This restructuring, in turn, bears on atmospheric cycles of water, ozone, and oxygen,[9] as well as on the cosmic microwave energy spectrum,[10] which the Physics Establishment insists is "proof" of an instantaneous "Big Bang" cosmic origin 13.7 billion years ago. For this reason and with much other evidence in hand, the cosmic microwave spectrum is seen to be no such proof at all of the "Big Bang."[11]

There is little doubt that the Sun has been shining for a very, very long time and providing the life-giving energy that drives the metabolic food chain of all life on Earth (deep subterranean microbial life perhaps excepted.) Modern physics

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thinks that it knows just about everything it needs to know about this glowing source of life, just as it imagines that it knows everything about fusion reactions from studying and postulating about the presumed reactions within Sol and other stars. Yet in truth, our knowledge about the innermost reactions within matter—and even about light itself—is just beginning. Much "firm" knowledge is at great risk, as discoveries before and after 1989 have shown. Let us follow the path of the light of this new knowledge as a broadly-based New Energy Age dawns. Perhaps solar power enthusiasts, who heretofore have been reluctant to join the rag-tag New Energy revolution, may now find good reason to look into it and then join forces with us.

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Dr. Eugene F. Mallove
President, New Energy Foundation, Inc.

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Power Performance of Stirling Motors Driven from Modified Orgone Accumulators

Paulo N. Correa, Alexandra N. Correa, and Eugene Mallove

Abstract

We have previously reported on the application of modified (or hybrid) Orgone Accumulators, referred to as HYBORACs, to serve as day and nighttime drives for low delta-T Stirling engines.[1,2] We now report on calibrated power determinations of the mechanical output of MM6 Stirling engines, performed with a string-and-pulley method and with a sensitive prony-brake dynamometer, and we compare these to the predictions from Schmidt theory for Stirling engines. For a near 20.5 hours continuous running—8 hours of which was during nighttime—the HYBORAC/Stirling assembly output 6.12 kJ, with a daytime power mean of 125 mW and a nighttime output power mean of 25 mW. Peak output power reached 165 mW.

Introduction

Simple sheet metal Faraday cages have been shown to be able to sustain positive temperature differences (To-T) with respect to their adjacent surrounding atmosphere, even under stringently controlled indoor dark basement conditions designed to minimize those differences.[3] (Here To refers to the temperature taken either above the top surface of the Faraday cage—usually within 1 to 2 cms of the top—or inside of it, near 2 cms below the top, and T is air temperature adjacent to the Faraday cage as measured by a suspended mercury thermometer, typically 30 cm laterally from the cage.) This anomalous thermal phenomenon was first discovered by W. Reich and later effectively confirmed by A. Einstein,[3] though unfortunately he accepted his assistant L. Infeld's quite erroneous attribution of the positive (To-T) to air convection currents. Because of the astonishing and revolutionary nature of this discovery by Reich, which is the groundwork for the present paper, it is important to summarize the non-scientific response of these "authorities" to the experiment: Einstein and Infeld pursued *no further experimental studies*, despite detailed critiques by Reich of their objections. This unscientific behavior would begin to characterize physicists' approaches to other challenging phenomena in the twentieth century, such as electrodynamic explosions and Low-Energy Nuclear Reactions (LENR), with their associated excess heat phenomena.

However, to develop from this (To-T) phenomenon a useful application that simultaneously permits a clear demonstration of the temperature differences and utilizes them to generate work, one must optimize the physical conditions that generate sensible heat inside and atop these cages, so as to make To-T as large as possible. W. Reich opened the way in this direction when 1) he insulated these cages to create what he termed Orgone Accumulators (ORACs) by employing special materials for their construction and layering alternating metal and thermally insulating materials, and then 2) proceeded to measure the temperature difference outdoors where he found that "it increases and decreases with the intensity of solar radiation."[4] This led him to directly expose these ORACs outdoors to solar radiation, having found that "on summer days, under a strong sun, (To-T) dif-

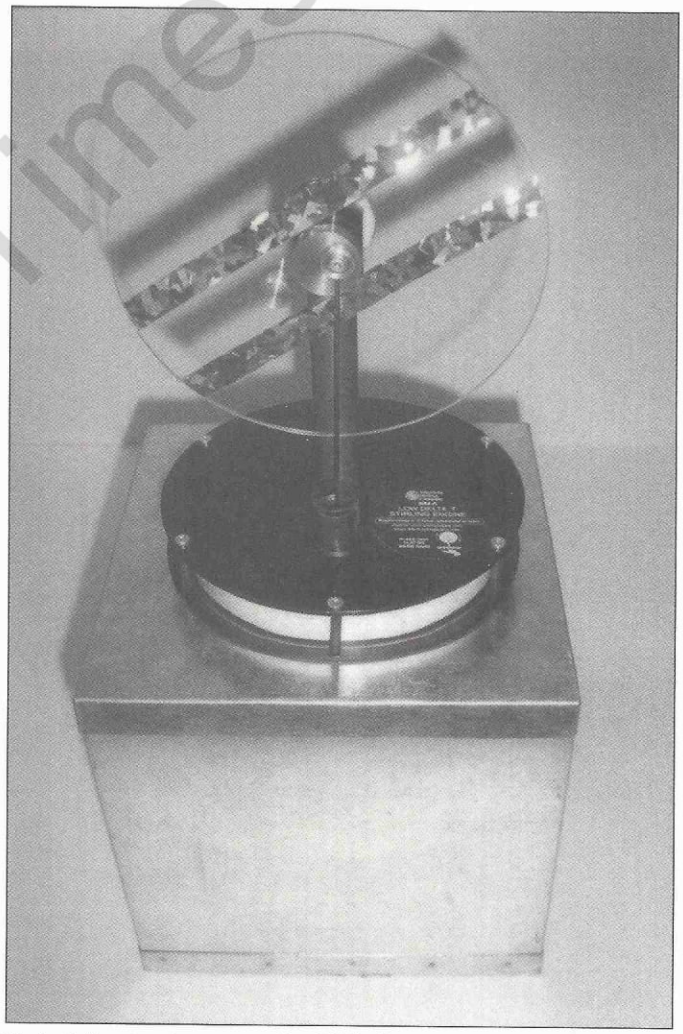

Photo 1. Front and top view of an MM6 Stirling engine resting on top of an 8 inch cube Faraday cage. In the HYBORAC/Stirling experiments performed in the Toronto, Canada area in May 2003, a similar 8-inch cube Faraday cage was employed.

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ferences up to 20°C are not uncommon."[5] Despite Reich's clear attribution of "atmospheric and ground orgone radiation" to the sun:

> If the radiation in question [*i.e.* orgone energy] were directly connected with solar energy, then many phenomena could be easily explained. . .Furthermore, [orgone] is radiated into the atmosphere by the sun and is therefore present everywhere. . .[6]

Despite even his explicit claim that he had "proof of its solar origin,"[4] self-styled Reichian followers have shrunk from confirming this proof, as much as from studying the effects of direct solar radiation upon ORACs.[7] It was the first two authors of this paper, in fact, who penned the first such scientific study,[8] demonstrating, with both ample experimental evidence and new analytical tools, how solar radiation consists fundamentally of what they appropriately described and named *massfree, longitudinal, ambipolar (electric) energy*, and identifying its exact energy spectrum.[9,10] The same two authors have also identified the modal spectra of IR (infra-red) photon absorption for black ORACs (peaks at 42.5 µm wavelength) and white ORACs (peaks at 45 µm wavelength) under solar exposure—and formally demonstrated how very-long wavelength IR absorption cannot in any way account for the sensible thermal energy generated inside these ORACs. This put to rest the spurious contentions of certain Reichians (*e.g.* J. DeMeo[7]) who believe that the thermal anomaly is caused by IR absorption.

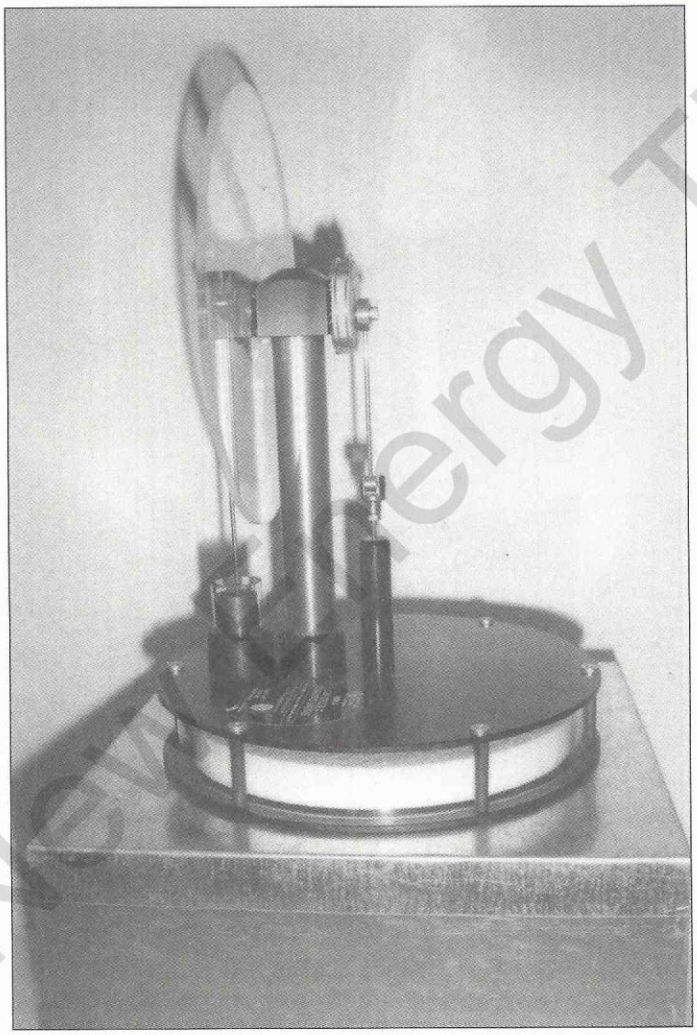

Photo 2. View of the MM6 Stirling engine used for weight-fall testing. Nylon thread wind-up spool, a slight modification to the MM6, is visible.

We have, in a previous publication, proposed a model for the evolution of sensible heat (blackbody photons) inside Faraday cages and ORACs.[2] Essentially, solar-atmospheric ambipolar radiation is captured by electronic and atomic matter, to which it confers kinetic energy (in the sense of the kinetic theory of gases, as energy of translatory motion), and loss of the latter results in the production of blackbody photons through specific aetherometric transformations.[9] However, ambipolar radiation can also be captured to confer *latent heat—i.e.* increase the energy content of "the atmospheres of molecules," or their "latent heat of phase change." This production of latent heat is, in fact, the dominant pathway, but has not been understood by "accepted physics" for reasons that are now all too clear. Undoubtedly the energy states to which "latent heat" refers are also kinetic energy states, but they are not normally understood as such because they relate to structural features—such as Van der Waals or noncovalent bonds and molecular phase states—that are thought to involve rotary or vibratory motions. In turn, this more comprehensive and accurately defined latent heat can also be released to produce blackbody photons.

Previous determinations[11] estimated the quantity of latent heat present inside black ORACs (BORACs) and sustaining a To-T = 10°C, to be at least 3x greater than the accompanying quantity of sensible heat. Modification of these BORACs was undertaken to maximize their To-T values both under direct solar exposure[1] and in total darkness,[2] by hybridizing them with matté-black special Faraday cages to create the HYBORAC design, with its two configurations—daytime and nighttime.[2]

The present communication reports on the mechanical power calibration studies of the MM6 Stirling engine, performed with sensitive spring-loaded prony-brake dynamometers. Other calibrations—with string-and-pulley, and quadrant and hung-weight prony-brake dynanometers—were also performed with similar results. These experimental tests were compared to the Schmidt theory of so-called γ-type Stirling engines—a class to which the MM6 belongs. The spring-loaded prony-brake dynamometer calibration was then employed to determine the mechanical output power of a typical experiment. To be precise, we measured the mechanical power of the Stirling engine mechanism as it expended energy against its own internal friction and resistance during steady state operating conditions—no additional loads external to the Stirling were employed in this study.

Note on Methods and Materials

With the exception of the string-and-pulley tests, which were performed on one particular low ΔT MM6 Stirling engine that was not coupled to a HYBORAC, all the experiments reported in the present communication employed the very same low ΔT MM6 Stirling motor (coded by us as "#2") made by the American Stirling Company in San Diego, California. (See Photos 1 and 2, showing side and front views.)

Results

Comparison of Faraday cages and ORACs exposed to solar-

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atmospheric radiation.

Early experiments identified evolution of much greater diurnal temperatures inside (2 cm below the top plate) matté-black Faraday cages than inside the inner chamber of 2x (*i.e.* interposed 2 metal and 2 insulating layers) matté-black ORACs (BORACs) having the same internal volume of 1 cubic foot, when both were directly exposed to solar-atmospheric radiation. The internal To-T values for these two apparatuses, together with the control values—for a metallic, uncoated Faraday cage of the same volume—are shown in Figure 1. Whereas the bare black Faraday cage reached To-T values of ≥30°C, when the BORAC only reached To-T values of 10 to 12°C, the BORAC was able to retain positive temperature differences longer into the nighttime, without letting the temperature difference turn negative. BORACs would reach 45°C with peak air temperatures of 30-35°C, while black Faraday cages would reach temperatures of 60 to 67°C, and up to 75°C on their outer top surface (so-called "heat waves" could readily be observed over the apparatus up to a height of 4 cm). The mean temperature values obtained from a comparative month-long study (during June and July, 1998) of their diurnal response outdoors were 40.45°C ± SEM 1.18°C (n=150) for the black Faraday cage versus 34.26°C ± SEM 0.62°C (n=171) for the BORAC. During the same period, a white-painted ORAC yielded a mean temperature of 27.13°C ± SEM 0.39°C. Mean air temperature was 25.56°C ± SEM 0.34°C (n=170), clearly indicating that all experimental devices could sustain a net positive temperature difference around the clock, even if some (the control metal cage and the black Faraday cage) presented negative temperature differences during nighttime.

Most of the early thermal studies that we conducted—on both sensible and latent heats—employed the BORAC as standard.[8,11] Even though the black Faraday cages performed better than the BORACs during daytime, they invariably led to null or negative temperature differences during nighttime.

From its onset, research and development of a hybrid of the two apparatuses—in the form of the HYBORAC design[1,2]—was guided by the key objective of sustaining large temperature differences around-the-clock, even though at the time no heat was being extracted from these devices to feed a work process. In essence, we aimed at increasing not just the daytime To-T but, above all, the nighttime To-T values—beginning with avoidance of the negative temperature differences. Considerable progress was made, in this respect, in the earlier investigations—enough to subsequently permit continuous extraction of energy during daytime and for up to 6.7h during nighttime.[1,2]

May 19, 2003 experiments

With the HYBORAC design described in our last report on this topic[1] and last tested during the late autumn days of 2002, we now sought to make a determination of its performance during spring. The daytime thermal difference values of the May 19, 2003 experiment are shown in Figure 2, and the corresponding nighttime values in Figure 3, with their respective DWLS (distance weighted least squares) curves. We need to introduce here ΔT, *not* to be confused with To-T! The ΔT refers to the temperature difference between the bottom plate (the "hot" plate) and the top plate (the "cold" plate) of the Stirling engine. Very high ΔT and To-T mean values of 17.7°C and 23.58°C, respectively, were

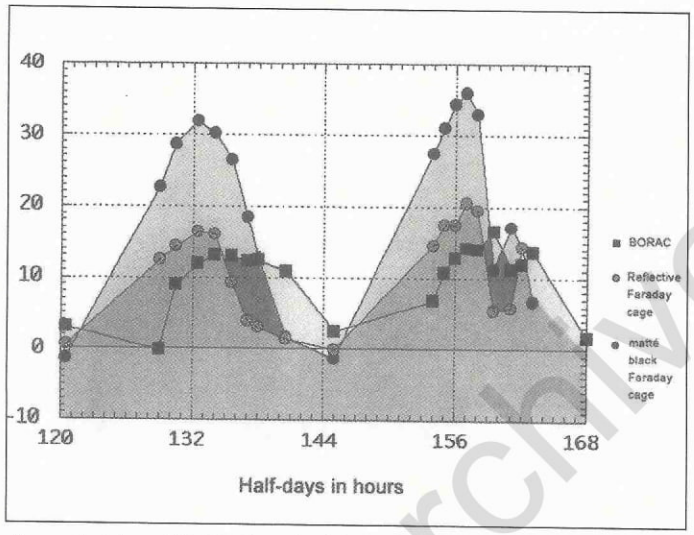

Figure 1. Internal To-T values for black ORAC (BORAC), for reflecting (bare) Faraday cage and for matte black (bare) Faraday cage.

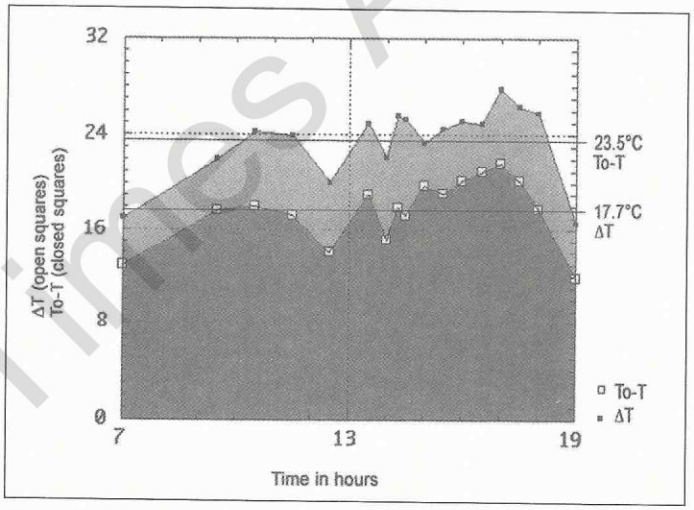

Figure 2. Thermal differences (daytime) for May 19, 2003 HYBORAC/Stirling testing. ΔT refers to the temperature difference between the bottom plate (the "hot plate") and the top plate (the "cold plate") of the Stirling engine. ΔT should not be confused with To-T difference, which pertains to upper HYBORAC surface temperature (To) references to ambient air temperature (T).

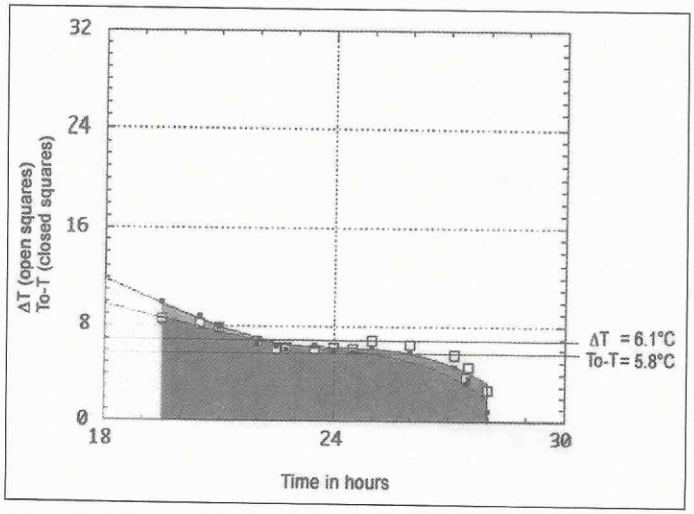

Figure 3. HYBORAC nighttime To-T and ΔT variation in the May 19-20, 2003 experiment. Note the inversion of the To-T and ΔT curves.

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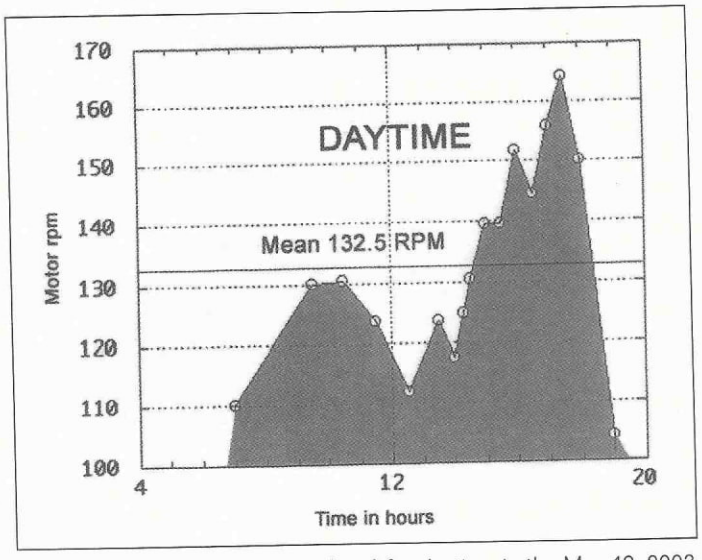

Figure 4. Stirling motor speeds (rpm) for daytime in the May 19, 2003 experiment.

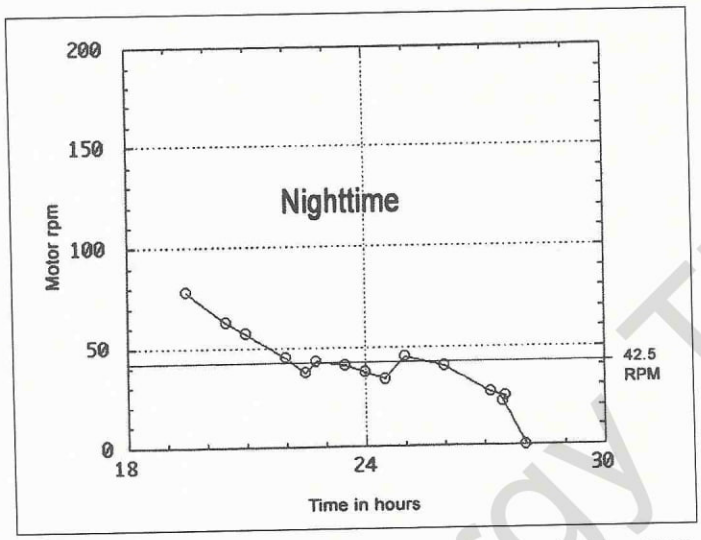

Figure 5. Stirling motor speeds (rpm) for nighttime in the May 19-20, 2003 experiment.

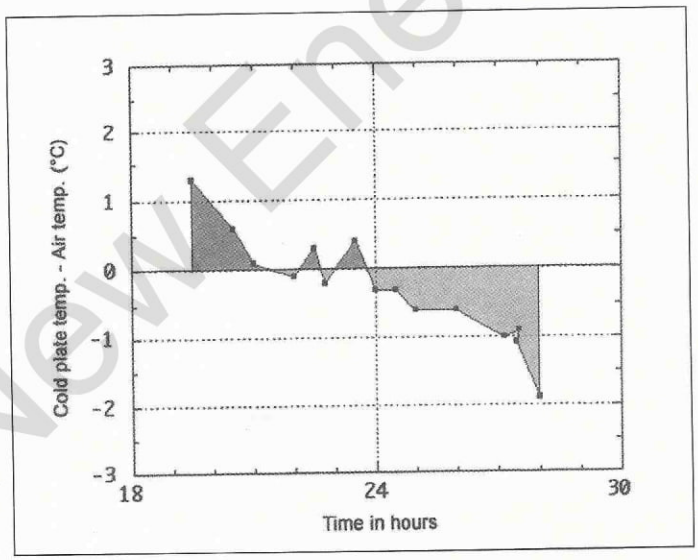

Figure 6. Nighttime inversion of the Stirling motor cold plate temperature with the control air temperature in the May 19, 2003 experiment.

registered during daytime, for a period of 12 hours; nighttime values, with means of $\Delta T = 6.1°C$ and To-T = 5.8°C were solidly positive for 8 hours, until near 04:00 when To-T abruptly decreased to 0.7°C. A typical inversion of the two curves (see Reference 2) was observed after midnight.

The corresponding motor speeds are shown in Figure 4 (for daytime) and in Figure 5 (for nighttime). Mean daytime rpm was 132.5, and mean nighttime rpm 42.5. The motor came to a stop after 03:37 in the morning of the next day, having been driven continuously for eight hours in the absence of solar radiation. The motor also ran continuously during the changeover (at 19:15) from the daytime to the nighttime HYBORAC configurations.

During the May 19 experiment we came very close to achieving round-the-clock motor action—the Stirling engine MM6 (#2) having worked continuously for 20.5 hours.

To progress further we needed to better understand the inversion between the ΔT and To-T values that is characteristic of the cooling period, and repeatedly accentuated towards the end of the motor activity. The motor did not come to a stop because these values became negative; rather, the To-T and ΔT values remained positive but decreased to a magnitude too low to drive the engine. Often this happened because of atmospheric condensation of humidity and its release of heat, with attendant rise of the dewpoint outside the boxes. This increased the air temperature and thus decreased To-T further. It also increased—with a lag—the temperature of the engine's cold plate, thus decreasing ΔT. The inversion could, in fact, be spotted by the negative trend in the temperature of the cold plate with respect to the air control temperature (see Figure 6): their difference becomes negative 2 hours after the nighttime configuration is adopted, settles after midnight, and exacerbates when the motor comes to a stop.

Schmidt analysis of the MM6 work and power outputs.
Schmidt theory of Stirling engines[12] assumes the performance can be determined from a P-V diagram, once the volumes of the engine and its dynamic cavities are known (see Figure 7)—along with the mass of the working gas and the temperature difference $\Delta T = T_{in}-T_f$ between the engine plates. The expansion moment volume, V_E, and the compression moment volume, V_C, are treated, the former as a function of the swept volume V_{SE} of the displacer-regenerator piston (also called the expansion piston), and the latter as a function of both swept volumes—V_{SE} and V_{SC}, the swept volume of the power piston (also called the compression piston):

$$V_E = [(V_{SE}/2)(1-\cos x)] + V_{DE}$$

$$V_C = [(V_{SE}/2)(1-\cos x)] + \{(V_{SC}/2)[1-\cos(x - dx)]\} + V_{DC}$$

where V_{DE} and V_{DC} are the "dead space" volumes of the expansion and compression phases of the cycle, and dx the phase angle between the displacer and power pistons (90° in these engines). For the MM6, the maximum volume of the expansion moment can be easily measured to be 141.37 cm^3. The swept and "dead space" volumes can also be determined by examining the internal geometry of the motor: $V_{SE} = 132.5\ cm^3$, $V_{SC} = 151.1\ cm^3$, $V_{DE} = 8.8\ cm^3$, and $V_{DC} = 18.6\ cm^3$ (at 0°). We also need to know the volume of the regenerator—which is the volume of the displacer piston—

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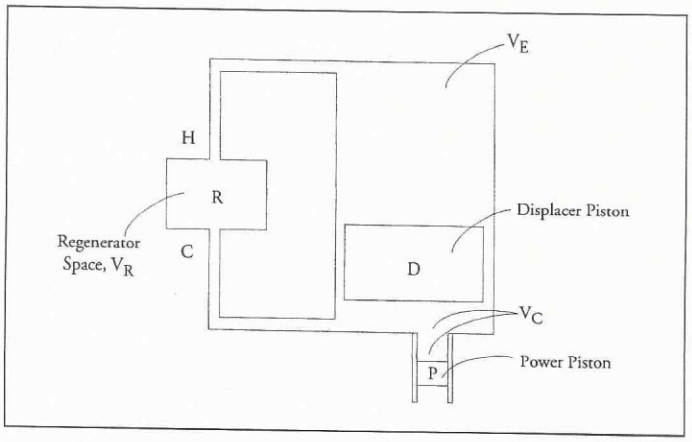

Figure 7. Schmidt interpretive model of the gamma-type Stirling engine.

and this, too, can easily be ascertained as $V_R = 247.4\ cm^3$.

To apply the Schmidt model[12] we need some other parameters that are specific ratios for temperature and volumes. We chose, for our inquiry, experimental data of a motor rpm mean of 118 rpm (1.967 rps), obtained outdoors with the HYBORAC/Stirling assembly in the daytime configuration, and a ΔT of 18.7°C. The temperature ratio t is:

$$t = T_f/T_{in} = 291.31 \text{ deg kelvin}/309.99 \text{ deg kelvin} = 0.9397$$

The swept volume ratio is $v = V_{SC}/V_{SE} = 1.14$, and the "dead" volume and regenerator ratios:

$$X_{DE} = V_{DE}/V_{SE} = 0.0667$$

$$X_{DC} = V_{DC}/V_{SE} = 0.1405$$

$$X_R = V_R/V_{SE} = 1.8666$$

From these parameters we then extract the values of the Schmidt functions: for the working angle a:

$$a = \tan^{-1} [(v \sin dx)/ (t + \cos dx)] = 50.5°$$

and for the Schmidt functions S, B and C:

$$S = t + 2tX_{DE} + [(4t\ X_R)/(1+t)] + v + 2X_{DC} + 1 = 7.111$$

$$B = \{t^2 + [2(t-1)\ v \cos dx] + v^2 - 2y + 1\}^{0.5} = 1.142$$

$$C = B/S = 0.1606$$

With these data, a P-V Schmidt diagram for the γ-type Stirling engine can be built, where the occupied P-V area corresponds to the work integrals for work-equivalent expansion energy (W_E, or input heat) and the work-equivalent compression energy (W_C, or output heat). The work equivalent energy per cycle ($W_{out} = W_E + W_C$) is then given by (P_{mean} is the standard atmospheric pressure of 1 atm = 101.35 kPasc):

$$W_{out} = [P_{mean}\ V_{SE}\ \pi\ C\ (1-t) \sin a]/[1+(1-C^2)^{0.5}] = 0.158 \text{ joules}$$

with an efficiency of:

$$eff_{Carnot} = W_{out}/Q_{in} = W_{out}/W_E = 1 - T_f/T_{in} = 1- t = 0.06$$

The power of the work performed over time is then simply given by:

$$L_{Schmidt} = W_{out} * rps = 0.3128 \text{ watts}$$

By the Schmidt model, then, an average motor speed of 118-120 rpm would constitute a power output of more than 310 milliwatts. If it were continuous, the work produced after 24 hours would be equivalent to the outflow of more than 27 kJ from the HYBORAC.

Experimental determination of the MM6 thermomechanical output power—preliminary determination of output power by gravity acceleration with a string-and-pulley method:

On a different MM6 of an earlier vintage (different shape and size small wheel, different regenerator materials and volumes, central shaft twice as large) the smaller "wheel" (radius of 0.0175 m) was completed with balsa inserts that added 0.8 gm, and calibrated weights attached to it with wire, with a total wire weight of 1.04 gm. The added weights of balsa and wire were, therefore, negligible. The balsa inserts were epoxied in place, and two wire guides—about 0.125-inch apart, serving as guides to prevent the ultra-fine nylon thread from slipping off—were attached to the small wheel. Friction through the hooks is also assumed to have been negligible (the suspension was threaded up toward the ceiling, then through two U-shaped nail hooks in the wood ceiling beam). The Stirling was rotated ("loaded") so that the small wheel wound up the nylon thread until the weight hung near the top hook. At t = 0, the larger wheel of the Stirling was released from the brake position and a digital stopwatch was activated. When the weight hit the surface, after a height of fall of 2.235 meters, the stopwatch was stopped. With this method, known as the string-and-pulley method,[13] the test engine appeared to reach steady-state speeds with the 10 and 20 gm weights. Calibration data are shown in Table 1.

The formulas used were:

$$rpm = (1.22 \times 10^3)/t_{FF}$$

TABLE 1

Test mass	time (in sec)	rpm	power (mW)
5 gm	16.2	75.3	6.76
5 gm	18.6	65.4	5.87
5 gm	19.4	63.0	5.66
10 gm	9.86	124	22.3
10 gm	9.81	124	22.3
20 gm	6.35	192	69.0
20 gm	6.43	190	68.2
20 gm	6.24	195	70.0
100 gm	2.99	408	73.3

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where t_{FF} is time of fall in seconds from the 2.235 m height, and for power:

$$L_{FF} = \text{torque}^* \text{ angular speed} = m\ g\ (0.0175\ m)\ (2\pi\ rpm/60) = mtest\ (1.8*10^{-5})\ rpm$$

with m_{test} in grams. Temperature difference between the hot plates and cold plates of this Stirling was, at most, ca 0.5°C (with no heat applied to either plate).

Calibration of the MM6 (#2) output power with prony-brake dynamometers, in the HYBORAC/Stirling assembly.

Initial power calibration of the MM6 (#2) motor employed in the open-air HYBORAC studies above, was carried out with quadrant-gravity scales: the scale, suspended vertically, was calibrated with 5, 10, 20, and 100 gm certified brass weights, and then its hook was horizontally attached, via a strong cotton string, to a nipple (mean radius r_n = 0.0053 meters) built to fit the shaft of the Stirling engine. Speed measurements were taken before and after each dynamometer reading of the test mass value on the scale, with and without the nipple on the motor, and no significant differences were observed. The flywheel shaft will come to a stop when the power of the force of friction being exerted equals the output power of the shaft:[13]

$$L_{dyna} = m_{test}\ g\ r_n\ (2\pi\ rps)$$

This gives power directly in watts, with the test mass in kilograms; g = 9.8065 N per meter.

The motor was set to the desired steady-state speed while driven from the HYBORAC, and the string was looped by hand two to four loops around the nipple before, on its own by friction, it instantly brought the motor to a stop—at which point, a peak reading on the quadrant scale was taken. Preliminary results were as shown in Table 2.

More accurate measurements were subsequently made with a pencil-type, spring-loaded prony-brake (absorption) dynamometer employing two scales, 0 to 100 gm, and 0 to 500 gm. The first was calibrated with 5, 10, 20, and 100 gm and the second with 20, 50, 100, and 500 gm certified brass weights. The scales were horizontally mounted at the height of the top surface of the nipple and the string ran directly from the nipple to their end. Care had to be exercised for the nipple mount not to exert friction on the shaft. The procedure was as described previously for the quadrant scale method, including measurement of motor speed before and after each test, with and without the putative nipple. The method of looping the string around the moving nipple takes great patience and some skill, and we found that moistening the hard rubber surface of the nipple permits a better traction for the looped string to arrest the motor.

The spring-loaded prony-brake dynamometer calibration was performed directly on the HYBORAC daytime assembly with the motor at steady state, while operating outdoors with typical ΔT values. The DWLS calibration curve for output power is shown in Figure 8a—six out of the eight points were means of n = 3 measurements, the other two were means of 2 measurements. Linear regression analysis of the data places an output of 57 mW at 100 rpm, 79-80 mW at 120 rpm, 86 mW at 123 rpm and 95-96 mW at 132.5 rpm (the daytime mean of the May 19 experiment), as shown in Figure 8b, with a slope of 1.15 mW per rpm. Peak output power tested was 175 mW at a speed of 187 rpm. The calibration of ΔT vs. motor rpm is shown, for the same experiment, in Figure 9, analyzed as linear regression with a slope of 6.7 rpm per °C of ΔT.

These results suggest that the Schmidt prediction is off by ca 4x from the experimental result, for the chosen comparison point (~120 rpm) situated midway through the calibra-

TABLE 2

Test mass (gm)	ΔT (°C)	rpm	power (mW)
35	6.6	64	12.2
>100	13.2	119	>64.8

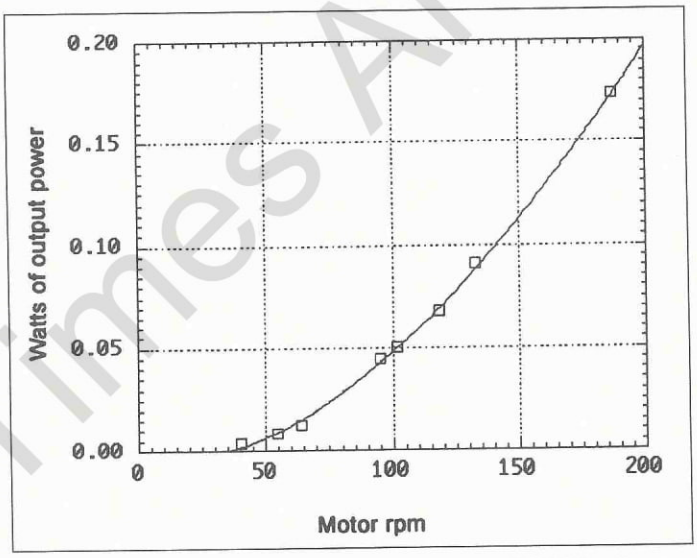

Figure 8a. Outdoor distance weighted least squares (DWLS) calibration curve for the MM6 (#2) Stirling motor output mechanical power as a function of motor rpm, while being driven by the HYBORAC.

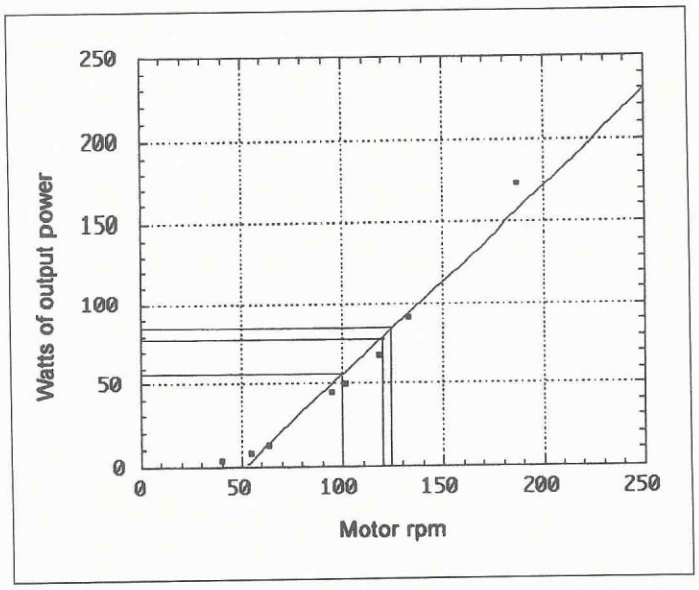

Figure 8b. Outdoor linear calibration curve for the MM6 (#2) Stirling motor output mechanical power as a function of motor rpm, while being driven by the HYBORAC.

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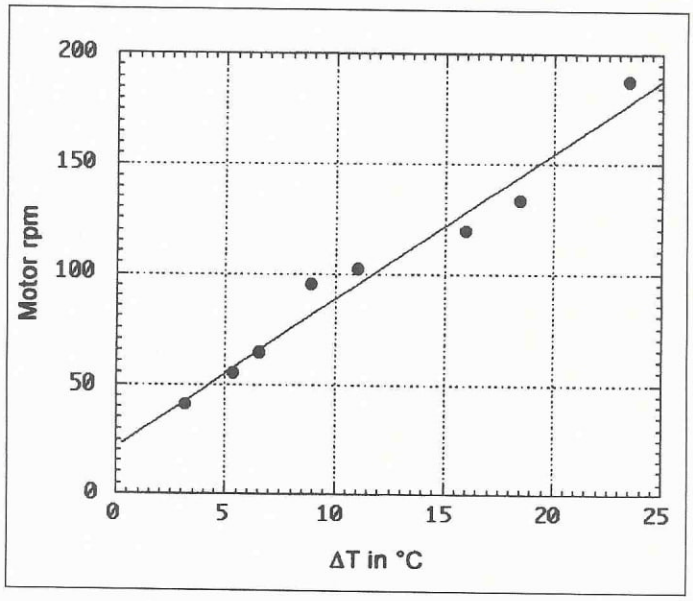

Figure 9. Outdoor linear calibration curve for the MM6 (#2) motor speed as a function of ΔT, while being driven by the HYBORAC.

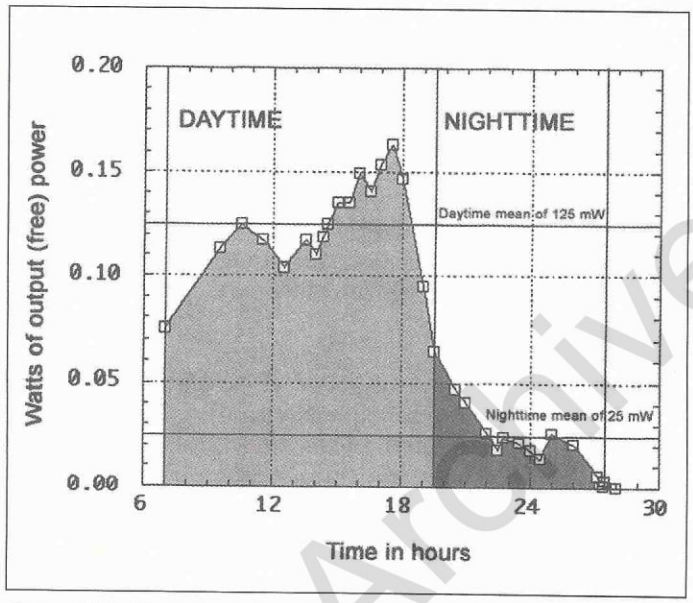

Figure 10. Calibrated mechanical output power of the Stirling MM6 (#2) during the 20.5 hours of the May 19, 2003 experiment.

tion curve (see Figure 8a). The results also cautioned us about the MM6 variability, underlining the necessity of testing throughout with the same motor and the impossibility of interchanging calibrations performed with different motors.

Calibrated power output from the May 19, 2003 experiment.
Linear regression analysis of the spring-loaded dynamometer calibration gave a slope of S = 0.00115 W/rpm. However, this skews the values in the low range (<50rpm) of motor speed. Accordingly, we refined the calibration function as follows (where 0.006 W/rpm is the mean for low speed from the DWLS analysis in Figure 8a):

1. For speeds greater than 50 rpm:
$L_{dynaoutdoors}$ in watts = (50 rpm * 0.0006 W/rpm) +[(S in W/rpm)(rpm - 50 rpm)]

2. For speeds lower than 50 rpm:
$L_{dynaoutdoors}$ in watts = (rpm * 0.0006 W/rpm)

We next applied this to the analysis of the May 19 experiment for the HYBORAC configurations previously described.[2] The output power results are shown in Figure 10 —with the daytime mean of 125 mW being sustained for 12 hours (a total daytime work of 5.4 kJ; with a mean of 95 mW, the total daytime work could be as low as 4.1 kJ), for a mean speed of 132.5 rpm

Peak daytime output reached 165 mW. The nighttime mean of 25 mW was sustained for 8 hours (a total nighttime work of 0.72 kJ). The overall daytime and nighttime mean output power was 0.077 W ± SEM 0.01 W (n = 32). The total work output in nearly 20.5 hours was 6.12 kJ. On an hourly basis, the daytime operation had an output at least 5x greater than the nighttime operation.

Comparison of the HYBORAC/Stirling technology to solar photovoltaic technologies.
We now compare the output power efficiency of photovoltaics to the thermomechanical output of the Stirling engines being driven from the HYBORAC.

Typical photovoltaic films of amorphous silicon (*e.g.* Millenia™ produced by Solarex) can, on average, produce 4Wh per day per watt rating.[14] A square meter of such photovoltaics would be able, in principle ("is rated"), to generate 163.2 Wh (587.5 kJ) per day. For the reference top-of-the-atmosphere surface solar radiation power constant of 1366 W m^{-2} (Reference 15) with a total daily energy of 32.78 kWh per square meter, the rated 0.16kWh to be captured per day, only constitutes an effective 0.48% efficiency. For an eight-hour period of solar radiation, and a total of 10.93kWh of energy, the efficiency figure (artificially) rises to 1.44%. This practical solar efficiency is, of course, less than the laboratory efficiency of crystalline solar cells, placed at 14%, and having a theoretical efficiency limit of 28%.[16]

Down in the atmosphere, at the Earth's surface, on a clear day, the zenith Sun will yield substantially less power than that of its power constant.[17] At 45° N latitude (our location is at 43° 41′ N Lat), a surface of 1 square meter with a 45° slope, on June 22 (after the summer solstice), receives an average of 688 Langleys per day,[18] or 28.785 million joules per day, with a total incident power of 333 watts per square meter. An effective surface of 0.0413 m^{-2} (a single face of the HYBORAC) under the same conditions will receive a maximum power of 13.76 watts, for a total incident energy—in a 14 hour day—of 693.5kJ, or 192.6Wh. An equal area photovoltaic would only produce

$$192.6\text{Wh} * 0.0048 = 0.9245\text{Wh} = 3.328 \text{ kJ}$$

of electric energy. Moreover, this assumes that throughout those 14 hours the photovoltaics were mounted on a solar tracker to keep that 45° slope constant (for purposes of comparison with the 45° slope of the HYBORAC face with respect to the sun). Spread over the 14 hours of solar exposure, this corresponds to a mean power of 66 mW and spread over the 24 hours of the day, it corresponds to a mean of 38.5 mW.

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If we now compare the mean power of photovoltaics spread over the theoretical 14h, with the 12h mean Stirling output of 125 mW, the latter outperforms the photovoltaics by 189%. If we compare the mean power of the photovoltaics over the limiting 24h period, with the 24h (day and night) mean of 77 mW (for a total work-equivalent energy accumulated through 20.5h), then the Stirling engine outputs at least 200% more work-equivalent energy than photovoltaics effectively output electric energy (77mW/38.5mW = 2), for the same collector area.

Conclusions

The Stirling engine is a two-pulse hot gas (*air* in these experiments) engine, with an expansion pulse of the displacer during the heating phase of the cycle and a minor compression pulse during the cooling phase that forces the displacer back towards the hot-plate side of the cyclinder. For the MM6 engine to continuously rotate, a ΔT greater than 3.2 to 3.5°C must be maintained between the hot and cold plates, irrespective of their absolute temperature. By our estimates, this requires a thermal power influx minimum of ca 250 to 300 mW, that outputs a scant <2 mW of power.

With a Carnot efficiency of 6%, the mean daytime mechanical output power of 125 mW requires effective provision (by the HYBORAC) of at least 2.08 watts of continuous sensible thermal power to the Stirling hot-plate—more than 100x the power of the sensible thermal flux measured as transiting through these boxes, and in accordance with the kinetic theory of heat. For the 20.5 hour experimental mean of 77 mW, and a Carnot efficiency near 4.3%, the HYBORAC must provide a mean sensible thermal power of ca 1.75 watts; and for the mean nighttime mechanical output power of 25 mW, with an efficiency near 1.6%, the HYBORAC must provide a sensible thermal flux of at least 1.5 watts. When considering the HYBORAC, where do these tremendous quantities of sensible heat come from? That is the question we shall address in the companion report—and which we now suggest must come from the latent heat accumulated by the HYBORAC through its capture of solar ambipolar energy. If we can experimentally confirm these values for the HYBORAC output that feeds the Stirling hot plate, then the combined efficiency of the HYBORAC at capturing solar radiation and releasing sensible heat may be as high as 200% that of passive solar collectors.

In trying to understand the properties of the Stirling engine, it is a useful exercise to analyze the reasons why Schmidt theory cannot accurately predict the power output of these engines. Schmidt theory assumes 1) that there is no pressure loss in the heat exchangers and there are no internal pressure differences, 2) that the expansion and compression processes are isothermal, 3) that the working gas behaves as an ideal gas, 4) that perfect regeneration takes place, 5) that the "dead space" volumes (of expansion and compression) are isothermal in their respective phases, 6) that the regenerator temperature is an average given by $T_R = (T_{in} + T_f)/2$, and 7) that the expansion and compression volumes behave according to a sine curve.[12] However, there are internal pressure differences at work, and like differences also in the heat exchangers. The compression and expansion phases are also not purely isothermal.

With efficiencies greater than photovoltaic for the total power output, the HYBORAC/Stirling technology is, perhaps, the most efficient technology available to capture solar ambipolar radiation or, more correctly, its byproducts, *i.e.* the latent heat it generates. This makes it an ideal and simple technology. Stirling engines are nearly silent engines that require no liquid or solid fuel, employ no valves or sparkplugs, combust no air mixture, and have no polluting emissions, let alone acidic ones. When driven from solar radiation they need no man-made external source of heat, as the steam engine does. They can be powered from geothermal vents, from industrial waste heat, or, best of all, from efficient capture of the energy of solar radiation by the coupling to the improved HYBORAC assembly.

The logic behind the HYBORAC design is neither new nor exclusive to the line of reasoning initiated by W. Reich and pertaining to the development of ORACs, BORACs, and HYBORACs. Back in the early 1930s, hot-air engines were used in remote areas to power fans from black-coated cylindrical heat reservoirs designed for solar exposure.[19] What makes the improved HYBORAC design so special is its high efficiency of capture of the byproducts of solar radiation, specifically latent heat.

Our next objective is twofold: 1) to increase the nighttime performance so that it eliminates the observed inversion of To-T and ΔT, and becomes comparable to the daytime performance; 2) to raise the overall performance so that the HYBORAC will have enough power to drive the Stirling engine around the clock. Experiments that succeeded in accomplishing these tasks and achieved around-the-clock performance and comparable day and night power outputs, for two full days (but in principle easily extendable for much longer periods, if not indefinitely), will be reported on shortly. (See monograph already posted on www.aetherometry.com.)

For purposes of comparison with one other prominent aspiring new energy source, the Stirling/HYBORAC technology in these experiments produces mechanical output power directly, whereas LENR "cold fusion" cells have produced so far only thermal excess power even when the "heat-after-death" (zero input power) phenomenon appears. Also, the mechanical output power (only against friction, for now) in these preliminary non-optimized devices is comparable in magnitude or even greater than the thermal excess power in many typical (but certainly not all) experimental LENR/cold fusion cells.

This is a concrete demonstration of the energy reservoir of the cosmic energetic aether, as sourced (in this application) in the Sun, but going beyond the heretofore incomplete physical models, such as the commonly understood "solar electromagnetic spectrum." It would involve some difficulty to come up with a simpler, cleaner, safer and quieter passive form of collection of a power that is "free for the taking," than the HYBORAC/Stirling combination. The aim of our next report will be to discuss our already achieved increased performance of this technology—greater and continuous round-the-clock power outputs.

Finally, we must remark that this demonstration technology is by no means the full extent of possible aether energy technology, as the first two authors of this paper

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have proved via their PAGD™ and Aether Motor technologies. Neither these nor the Stirling/HYBORAC technology employ nuclear changes, with their accompanying hazards, however minimal these may seem in many present LENR experiments.

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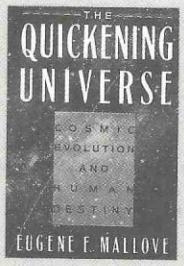

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Gravitational Data During the Syzygy of May 18, 2001 and Related Studies

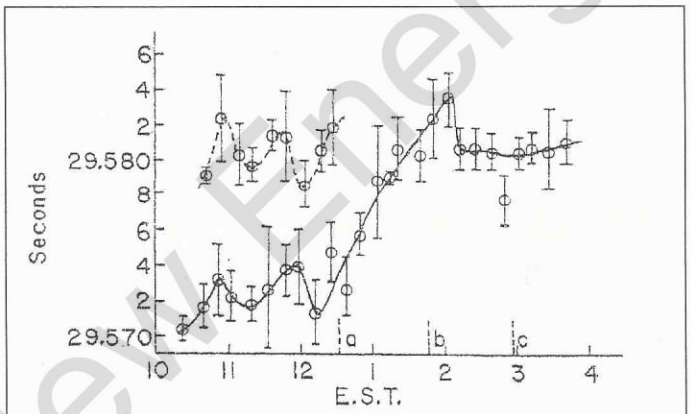
Gary Christopher Vezzoli*

Abstract

During the period of the line-up of Earth-Sun-Jupiter-Saturn on May 18, 2001, gravitational measurements were taken employing a two-pendula system, the small inter-pendula separation interrogated with a cw HeNe laser. The results are in accord with the anomaly in gravity that was detected during the total solar eclipse of March 7, 1970 reported by Saxl and Allen[1] and with the anomaly reported by Allais for the 1954 and 1959 total solar eclipses.[2] The results of our work, taken on a local scale, cannot be explained by classical gravitational theory, in accord with the conclusions of others.[1,2] Supporting evidence for astrophysical events affecting other terrestrial measurements are afforded from measurements on radioactive decay of Po-210 during the period when Jupiter eclipsed the deep space quasar J0842+1835 in September 2002.

Introduction

The data of Saxl and Allen[1] are reproduced in Figure 1 for the March 7, 1970 solar eclipse, which was 96.5% total in the Boston area. This representation of data plots the period of a long-period pendulum as a function of the time into the eclipse. As peak darkness is approached, the period of the pendulum changed continuously from 29.570 sec to 29.581 sec, a range much larger than any uncertainty in the experiment. Reference 1 gives the details of the experiment. The authors conclude that the variation in period is far too great (actually of the quantitative order, but opposite sense, of the effect of the Sun) to be explicable through classical gravitational theory (which conventionally examines the relative change in the position of the moon with respect to the Sun and the Earth).



The times that are required to traverse a fixed part of the path of oscillation vs the hour at which the data are taken. The letters a, b, and c indicate the onset, midpoint, and endpoint of the eclipse. [Dashed line inset refers to data taken two weeks later at when Sun and moon are on opposite sides of earth]. (1)

Figure 1. Gravitation data of Saxl and Allen corresponding to March 1970 eclipse of the Sun. Note the smooth rise in the time of a fixed part of the path of the oscillation of the torsion pendulum (ordinate) corresponding to the onset of the eclipse, and the sharp drop-off at the midpoint of the eclipse event followed by flat behavior.

The work of Allais[2] reported that during the 1954 solar eclipse, Foucault pendulum measurements in Paris indicated a change in angle of rotation by 13.5 degrees. The Foucault effect was recorded at 0.19 degrees per minute, but both before and after the eclipse the pendulum experienced normal behavior. The results were repeated three times in 1954 and in 1959 in France at St. Germain and Bougival in an underground gallery at a depth of 57 meters. The Foucault anomaly, however, was *not* observed in the July 1990 eclipse in Finland, and not observed in the 1954 event in Shetland, Scotland, using static gravity meters, and not observed in Trieste, Italy in 1965 (probably because the eclipses were not total at laboratory locations).

The problem facing existing theory is *not* that Newtonian gravity (with corrections from General Relativity) would not predict such an effect of perturbed "pull of gravity" during an eclipse, but such a perturbation should show smooth and symmetric quantitative behavior, unlike the non-linear data given by Saxl and Allen, and by Allais, and Newtonian theory would predict an effect of a considerably *less* magnitude for the change in period of the pendulum.

Other reported gravitational data that are *not* in accord with Newtonian or General Relativity gravity include the very meticulous vacuum work of Hayasaka and Takeuchi, who report a weight loss for the spin direction of a gyro with the spin vector pointing *opposite* to the Earth's rotation, yet no change in weight for the opposite spin.[3] Similar-trend data are given by Quinn and Picard,[4] however the magnitude of the asymmetric effect is reported to be only 5% of that of Reference 3. Non-supporting data for the weight reduction gyro study are given in References 5-7, however, in these studies either a vacuum was not employed, or a much weaker average vacuum was utilized compared to the work of Hayasaka and Takeuchi. Further measurements that are *not* in accord with Newtonian nor General Relativity gravitational theory are reported variations in G as a function of temperature[8-10] giving $[G=G_0(1+aT)]$, and preliminary measurements indicating change in weight due to change in shape, and due to change in phase.[10] In the change-in-shape change-in-weight study,[10] the energy input into the mass (a 1 mill Cu wire) was only a few ergs, which is vastly less than the energy equivalent of the mass itself, hence the input work can not account for the measured weight change.

In our laboratory we measured the period of a 22.35 gm stainless steel pendulum as a function of the separation distance (outer-surface to outer-surface) from an 88.00 gram

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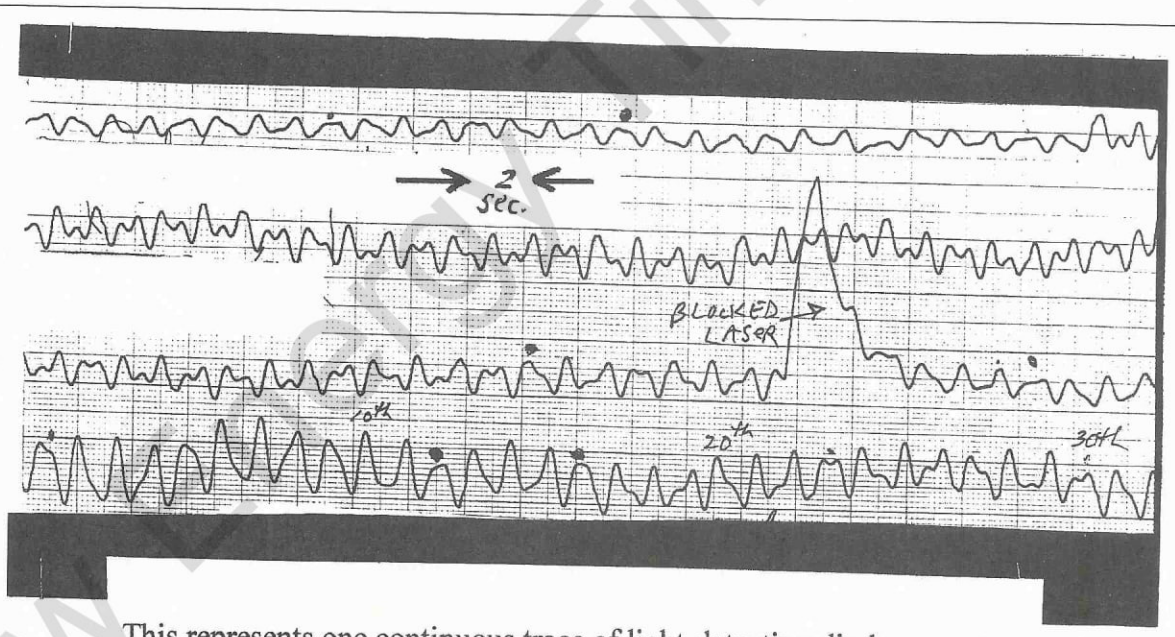
stainless steel pendulum suspended statically, but able to swing in the *same* x-z plane, and subsequently from a 1.3 kg iron pendulum. The closest distance from outer surface of one pendulum to outer surface of the second pendulum is referred to as the length scale. We observed that at a length scale of about 0.1 mm separation, the data could *not* be explained by the Newtonian inverse square gravitational relationship (see Reference 11). Such anomalous and unconventional behavior at length scale less than ~0.1 mm was predicted theoretically and reported[12] shortly prior to our discovery, but unbeknownst to us at that time. We also measured anomalous dwell times corresponding to the lower-mass lower-surface-area pendulum *lingering* close to the higher-mass higher-surface-area pendulum. These dwells occurred at random and unpredictably and will be discussed subsequently herein. Plotting the change in the period of the 22.35 gram pendulum as a function of the product of the masses of the two pendula, or versus the surface area of the greater-mass pendulum—in both cases—revealed a parabolic type dependence of the type $y = -a(x-x_o)^2 + y_o$. These hyperfine pendula studies do not conform to continuous oscillations associated with simple harmonic motion. Dwell or lingering events (where the lower mass pendulum remained near the larger mass pendulum as a short interruption of continuous motion) are shown by the truncated peaks in the wave train signal of Figure 2, indicated by dots over the signal. This trace refers to the output of a light detecting diode as the scattered and transmitted intensity of the inter-pendula interrogating laser signal varied because of the gravitational interaction induced motion of the two gravitating test pendula. The up-direction of the signal refers to lower detected laser-intensity incident upon the light detecting diode, and thus the gravitating bodies being closer together. The apparatus utilized to obtain the data of Figure 2 will be described in the next section. These random signals are *not* interpretable in terms of classical gravitation time-independent field theory.

Apparatus and Experimental Procedures

Figure 3 gives a schematic of our apparatus, which consisted of two independent pendula, the smaller mass pendulum (23.35 gm) being part of a Newton cradle dual nylon cable suspension system supported by a laboratory triple beam balance system, and the larger-mass pendulum supported by a second dual-nylon cable Newton cradle system for an 88 gram mass. Both pendula are free to move only in the x-z plane, as shown in Figure 3. Additional experiments were conducted by replacing the 88 gram pendulum with a single string suspended 1.3 kg mass pendulum. The double (dual) cable, with vertex at the pendulum solid sphere bob, heavily dampens any tendency to oscillate in other than the x-z plane. The length of each of the suspension cables of the 22.35 gm pendulum was 12.0 cm, the length of the dual suspension cable of the 88.00 gram pendulum was 30.0 cm, and the single-cable suspended 1300 gram pendulum was 40.0 cm. The resonant frequency of the 88 kg pendulum was 1.37 Hz. The entire system was placed on an optical air table, and enclosed in an isolation screen customized containment. A



This represents one continuous trace of light-detecting diode current versus time rather than four separate channels. Up direction (+Y) indicates lower incident laser light transmitted between the gravitating pendula spheres (higher gravity).

Figure 2. Wave-train signal giving the output of the light detecting diode due to being impinged upon by laser light that interrogates the inter-pendula separation of two Newton cradle pendula (as a function of time), both oscillating in the x-z plane; higher current output corresponding to greater laser incidence (corresponding to greater separation of the pendula) in the negative (- y) vertical direction. Recorder at 2 sec/cm. See scale on figure. Note the flattened signals (identified with a dot above the truncation) indicating a random dwell of the lower-mass pendulum in the vicinity of the higher-mass pendulum. This dwell lasted typically 0.12 seconds, and was unpredictable in its presence. We attribute the effect to a nonuniformity or gradient in the number density of the flux of external particles that give rise to gravity through a collision process.

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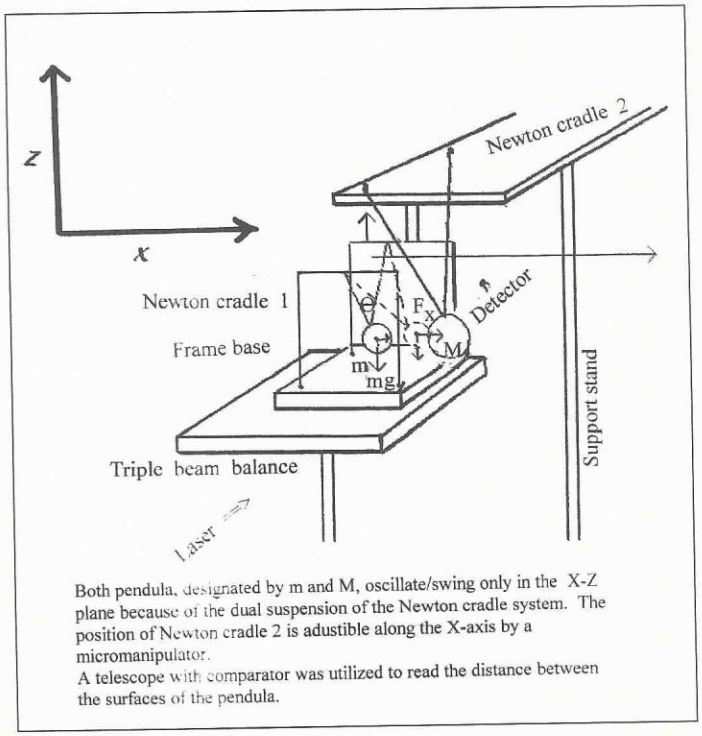

Figure 3. Schematic of the two-pendula measurement system, excluding the screened enclosure and laser. All dimensions given in the text. Calibration indicates sensitivity better than 10^{-14} Newtons.

100 mw He-Ne cw laser was directed (in the + ydirection) through the narrow gap between the two pendula (perpendicular to the oscillation plane of the pendula), however, since the beam cross-section was of greater width than the inter-pendula separation, some of the laser light was scattered by the pendula. The transmitted/scattered laser beam was directed to a light detecting diode. The optical path-length of the light beam was 30.0 cm from laser to the inter-pendula separation, and was varied from 10 to 20 cm from the inter-pendula separation to the light detecting diode. Some of the laser light that was scattered from the pendula was also incident upon the light detecting diode. The output of the light-detecting diode was fed into the input of a Goerz 7800 chart recorder, and in some cases to an oscilloscope and/or a computer with A/D converter. The power sources were equipped with isolation transformers and voltage stabilizers. The Goerz 7800 chart recorder was modified with a special RC filter system to avoid extraneous signals and parasitic effects. Data were generally taken at 6:30 a.m. and 2:45 p.m. EST when the educational institution, where the experiments were conducted, was almost completely empty of staff and students. Data were taken in a remote corner of the laboratory. The positions of the pendula were interchanged to probe any effects that may be due to the masonry side of the laboratory versus the windowed side. All experiments were repeated fifteen times. Frequency of pendula oscillation were measured by a photo gate, and verified by an independent timing device. The inter-pendula separation (length scale) was read by a telescope system equipped with a comparator. Many experiments were recorded with a camcorder and projected onto a 21-inch television monitor, as well as recorded on VHS video tape so that they could also be viewed frame-by-frame. The only source of interior illumination was the HeNe laser. Solar illumination was blocked by opaque baffles on the windows. All air-flow was turned off in the laboratory when measurements were conducted. No drafts were detected by various wind gauges near the experimental set-up. By employing as a control fixed spheres at fixed inter-sphere distances (same masses as the pendula spheres) we showed that there was no observable significant variation in the intensity of laser light, as a function of time, impinging upon the light detecting diode, beyond very minor background due to micro-vibrations of/in the building (which was remote to any street or parking lot by at least 50 meters). The absence of stray magnetic fields and electric fields was insured by the use of a milligaussmeter and a series of galvanometers and electroscopes (in conjunction with the screen enclosure). There was no indication that a Casimir effect was present that could influence the interpretation of the data. Calibration with a torsion pendulum indicated that the laser scattering technique was capable of readily measuring one part in ten billion (using a digital nanoammeter accurate to 0.1 na). With this system we were able to measure relative motion due to forces of 10^{-14} N.

Work which was aimed at studying the effect of length scale on the validity of the inverse square relationship utilized 2.0, 1.0, 0.6, 0.2, and 0.1 mm as the inter-pendula spacing. For the syzygy study reported in the next section, 0.6 mm was employed for the inter-pendula spacing.

Measurements During the Planetary Line-up of May 18, 2001

Computer codes predicted a syzygy of Earth-Sun-Jupiter-Saturn to occur at 2202 (UT) on May 18, 2001, with a very precise line-up of centers of less than 1 degree variation. We conducted continuous measurements of the motion of the two pendula (22.35 gm and 88 gm) from 1730 UT to 2330 UT on May 18, 2001. *We detected a 35 sec anomaly in gravitational behavior in the form of a decrease in gravitational interaction of the two pendula at 2010 UT.* The raw data analogue trace (upper part of figure; lower gravity in the *lower negative vertical direction* on the figure), and the point-by-point digital data profile are plotted in Figure 4a (lowered gravity in the *positive vertical direction* for the X data; in the negative vertical direction for the raw analogue data). For hours prior to, and for hours subsequent to, the 35 sec dip in gravity anomaly, the analogue trace showed an approximately constant level of light incident upon the light-detecting diode (approximately constant gravity), using the amplification level associated with the data trace in the upper part of Figure 4a (a lower amplification/sensitivity than what was employed in the data of Figure 2). These digital data show a point-by-point profile that resembles remarkably well the eclipse of the Sun data given in Figure 1, and are plotted in the inverse sense of the analogue trace in order to bring the similarity of the eclipse data and the syzygy data to the reader's attention. Measurements of the weight of the Newton cradle pendulum apparatus showed a cusp-like dip between the hours of May 14, 1800 UT and May 15, 1100 UT; these weight measurements were conducted twice daily throughout the month of May 2001. The data are shown in Figure 4b. The dip correlated with a decrease in the charge density pulse data in the North Carolina net observed during the interval of 0500 UT and 0900 UT on May 15; see Reference 13. It is not yet established, and still speculative, why the

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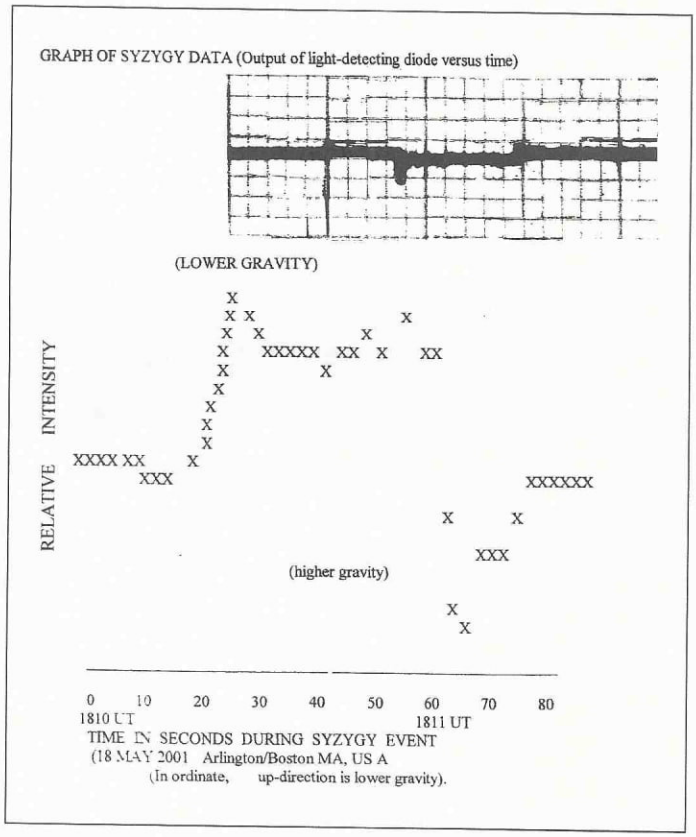

Figure 4a. Data profile for the May 18 syzygy event, measuring increased laser light intensity incident upon light-detecting diode (lower gravity) in the positive vertical (+ y) direction versus time into the syzygy event (lower X data). In analogue form (upper trace data) the 35 sec anomaly appears as a rectangular increase in incident-intensity upon the light detecting diode (corresponding to a dip in gravity; lower gravity in the - y direction of the trace); however, when the fine structure is plotted digitally (lower X data), one can see similarity in profile to the data given in Figure 1 for the total eclipse of the Sun. The shoulders of the data may suggest a short transient increase in gravity. During the 35 second dip in gravity associated with the syzygy, the two pendula could be observed through the telescope system as remaining essentially at a maximum separation from each other.

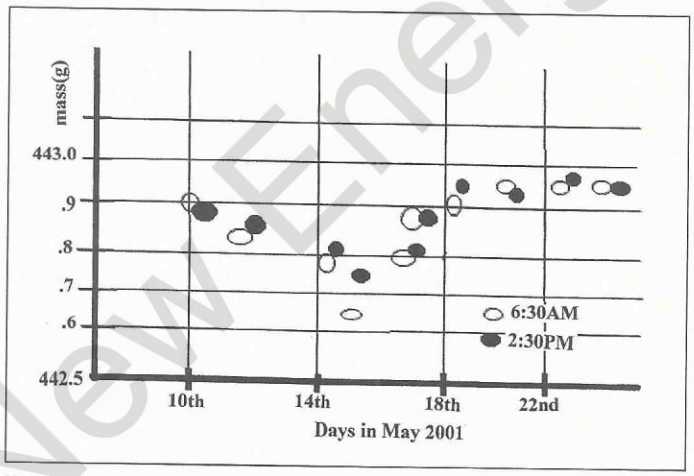

Figure 4b. Weight measurements of apparatus system (that was shown in Figure 3). Data taken from May 10, 2001 through May 23, 2001, twice per day (open circle data measured at 6:30 a.m. EDT; closed circle data measured at 2:30 p.m. EDT). The cusp interval shown in the data is associated with a period of syzygy of Earth, Sun, and Jupiter (followed by the line-up of Saturn on May 18).

cusp in the weight data (Figure 4b), and the gravitating pendulum data anomaly (Figure 4a) occurred a few days apart during the same general syzygy event.

Interpretation of Syzygy Data

Our results, and the data of Saxl and Allen, as well as the data of Allais, seem more in accord with a quantum gravity model, based on external omnidirectional particles, than with a Newtonian model, tentatively suggesting that the fundamental source of gravity is due to external particles undergoing momenta transfer and inelastic scattering involving quantum effects, and thus gravity is induced and falls in the general category of a "push" gravity. [Quantized gravitational behavior has been recently observed and reported using collimated neutrons,[14] reporting also that free fall is *not* continuous but occurs in a series of "jumps" (which is in agreement with our macroscopic work on clusters of water molecules in free-fall, to be described subsequently herein).] In an external particle model of gravity, astrophysical bodies such as the Sun, moon, and planets then can be expected to interfere with a stream of generally omnidirectional particles and cause local anomalies measurable at Earth laboratories. We had previously authored, and recently presented, a theoretical manuscript on a model of induced gravity based on imbalanced momenta transfer from elementary particles, in the form of partly elastic but mostly inelastic collisions involving quantum-mechanical phenomena and exchange (see Reference 15).

Calculations indicate that the Earth-Sun system is in the shadow of Jupiter for about 12 hours, hence the short duration 35 sec signal associated with the syzygy suggests an effect related to very precise line-up relative to a *region* of the Sun. The peripheral region of the Sun at the chromosphere-photosphere boundary, within which the temperature of the Sun rises from 10,000 degrees to 1,000,000 degrees, corresponds to a zone of about 1,000 km, across. The orbits of Earth, Sun, and Jupiter are very well known, and calculations show that the shadow of Jupiter would require about one-half minute to pass this 1,000 km region. On the other hand, the measurements that we cited above on May 14 to May 15 are in agreement with the shadow of Jupiter crossing the entirety of the Sun in about 12 hours. Further future work by others during eclipse and during syzygy will be valuable to reach definitive conclusions.

Decay of Po-210 During Jupiter Eclipsing Quasar J0842+1835 and During the December 4, 2002 Total Solar Eclipse

In order to test the above cosmophysical model of perturbation of local gravitational interactions, we examined both the electromagnetic interaction using a magnetic pendulum, and interactions that give rise to radioactivity (weak force). The magnetic pendulum work was supportive of the local effects and will be treated in the last section of this paper. The radioactivity data are given below.

We measured the alpha decay of Po-210 as a daughter product of radon decay. Measurements were conducted with the Rad 7 solid-state detector every four hours for 32 days. The data indicated a peak in alpha particle production corresponding to a lunar variation; and a twice daily (from Chapman analysis) variation every 12 and 25 hours, however, the latter having a smaller range of variation (that was

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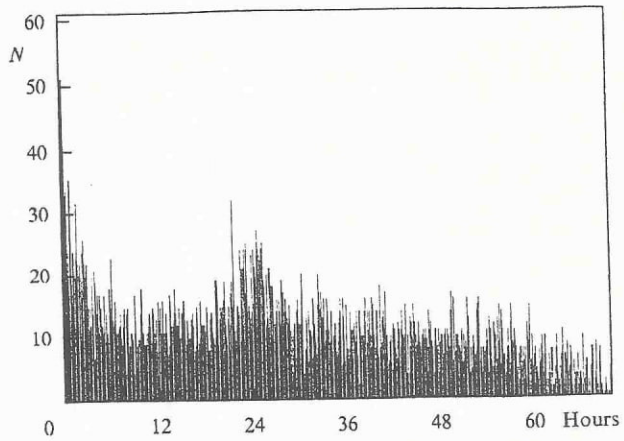

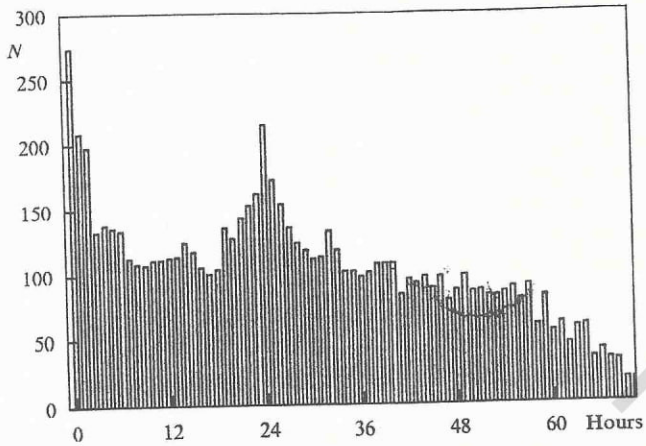

Figure 5a Distribution of time intervals between histograms of similar shape. Histograms are plotted each from 60 results of 6-second measurements of alpha activity of ^{239}Pu preparation — that is, over 6 minutes each; (a) the step along the horizontal axis is 6 minutes; (b) the step along the horizontal axis is 1 hour (10 histograms).

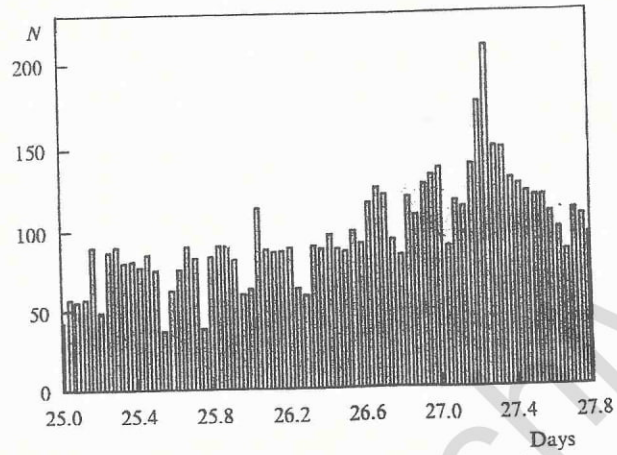

Figure 5b Distribution of intervals between recurrence of histograms of a given shape around 27 days. Histograms plotted from 60 results of 6-second measurements of alpha activity of ^{239}Pu preparation. The step of distribution is 1 hour (10 histograms).

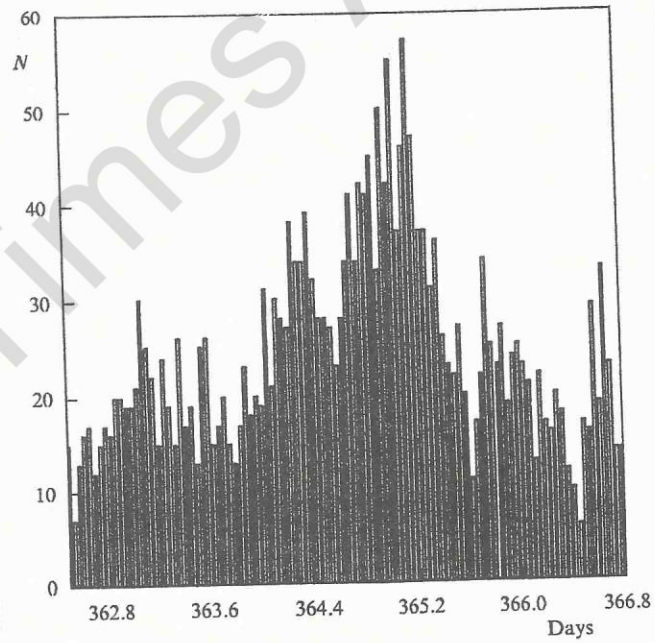

Figure 5c Distribution of intervals between recurrence of histograms of a given shape around 360 – 367 days. Histograms plotted from 60 results of 6-second measurements of alpha activity of ^{239}Pu preparation. Observe three sharp extremes, corresponding to recurrence of histograms after 364.4, 365.2, and 366.6 days.

Figures 5a-5c. Reproduction of the data of Schnol' *et al.*[16] showing daily, monthly, and sidereal year variation of histogram radioactive decay in Pu-239.

though still more than what might be attributed to Poisson statistics). The fifty years of histogram data on decay of Pu-239, by Schnol' *et al.*,[16] indicated a daily, monthly, and sidereal-year histogram variation, thus suggesting that the daily variation which we recorded (conducted at Harvard) was probably *not* due to conventional expectations of Poisson statistics, but to a complex cosmophysical effect. The Schnol' group concluded that the particle decay *daily, monthly, and yearly variation* indicated the presence of phenomena related to cosmogonic and cosmophysical factors (data of Schnol' in Figure 5). The clear-cut variation in radon decay with the Earth's tides is given in Reference 17. Recent additional work by Schnol' *et al.* compared data taken by use of a collimator pointed to the North (polar) Star, and also a collimator pointed due west. Only the data taken using the collimator oriented toward the west showed the unique histogram patterns, thus indicating the importance of the Sun in the explanation of the phenomenon giving rise to the histogram patterns. We employed the identical Rad 7 system to explore for any correlated effects during the period of September 7-11, 2002, when Jupiter eclipsed a deep space quasar. These data are given in Figure 6, and indicate minima (troughs at 6:00 a.m. - 10:00 a.m.) approximately commensurate with one rotation of the Earth, then giving support for local variations related to astrophysical line-up, and strengthening the argument of the importance of external particles influencing physical phenomena. Very recently, examination (by Ed Fomalont of the National Radio Astronomy Observatory in Charlottesville, Virginia, and by Sergei Kopeikin of the University of Missouri in Columbia) of the same event of Jupiter eclipsing quasar JO842+1835, in relation to studies aimed at determining the speed of gravity, have concluded that contrary to the

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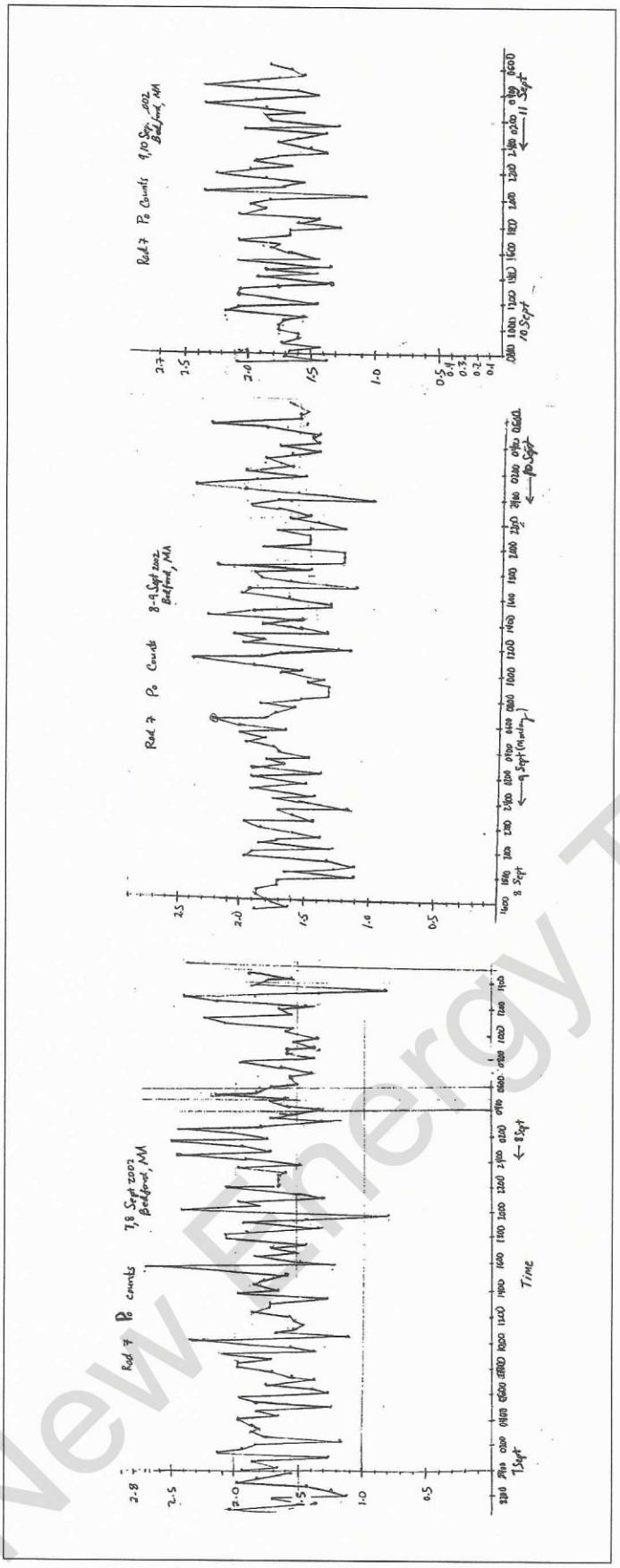

Figure 6. Alpha particle decay for Po-210 from fixed mass of radioactive decay of radon during the period of Jupiter eclipsing a deep-space quasar J0842+1835 September 7-9, 2002. Note the troughs occurring daily from about 0600 - 1000 EDT.

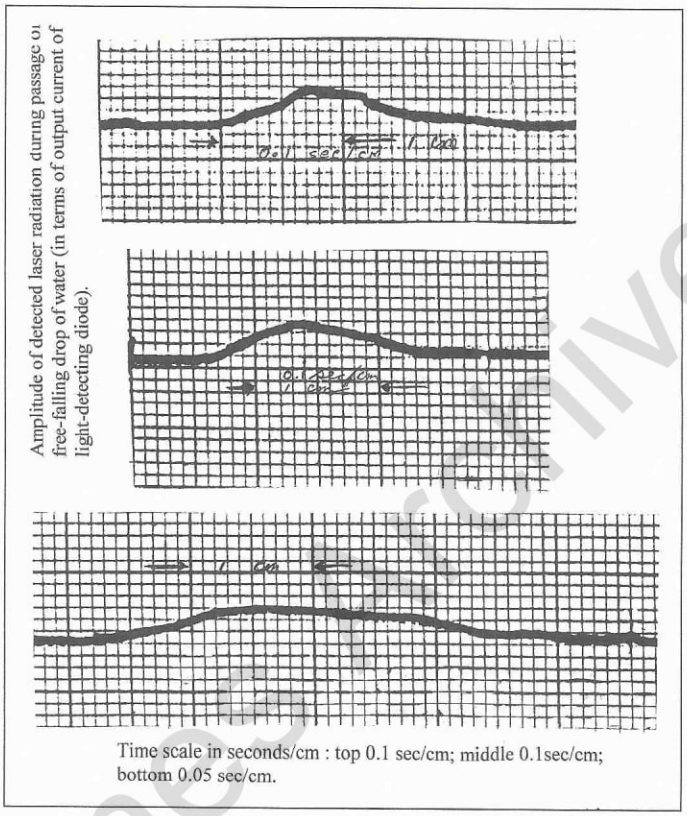

Figure 7a. Signature pulse showing detected laser light as a function of time, as a free-falling droplet of water crosses the path of an orthogonal-directed HeNe 100 mw cw laser. Note the non-symmetry and non-smoothness of the time profile for two different recording speeds as labeled.

Newtonian claim that gravity propagates instantaneously, the eclipsing of the quasar measurements confirm Einstein's General Relativity affirmation that gravity "travels"/propagates (or gravitons travel) at the speed of light. This conviction was also paramount to our own theory of induced gravity, otherwise if gravitons traveled at less than the speed of light (non-relativistic), then the drag effect would be so severe that the Earth's orbit would not be stable. [There are indeed those who believe that the speed of gravity exceeds that of light.] The graviton being relativistic insures conforming to the Einstein postulate that relates to light, namely that there is no measurable or meaningful rest frame of the graviton flux for the Earth or any planetary/celestial body to move into and undergo a drag phenomenon. The anomalous dips in radioactive decay during the total eclipse of the Sun on December 4, 2002—measured by colleagues on the dark side of the Earth (when the umbra/shadow was closest to the radioactive source) and when the eclipse was total in Southwest Australia on December 4, 2002—will be discussed in a subsequent paper but conform to the above interpretation.

On the Free Fall of Water and Its Deflection by an Electrostatic Potential

Reference 14 reported that using collimated neutrons, free fall does not occur smoothly but in a series of jumps, indicating quantization. We conducted laser scattering studies of free falling water droplets, using a system described in detail in Reference 10, in order to determine whether irregularities could be found in free-fall experiments of macroscopic clusters of molecules. The change in the detected intensity (see

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Figure 7a) of a 100 mw laser beam as a function of time (directed orthogonal to the free-falling water droplets) does not indicate a symmetric and well behaved signature that would be expected to be commensurate with a constant acceleration due to gravity (given as ~981 cm/sec/sec), but suggests a changing acceleration. The laser scattering signal was different for each of the hundreds of droplets that were studied. Data are shown in Figure 7a. Even though the recording speed of the X-Y recorder utilized in the study is far slower than would give an exact reproduction of the acceleration properties of the falling drop, nonetheless, the non-smooth behavior of the signal is representative of the manner with which the falling droplet interferes (interrupts) with the fixed laser beam. Although the shape of each water droplet is somewhat different in the act of free-fall in air, nonetheless the general elongated spheroid or ellipsoidal shape, when in an accelerating gravitational field, should not give rise to flattened profiles of Figure 7a.

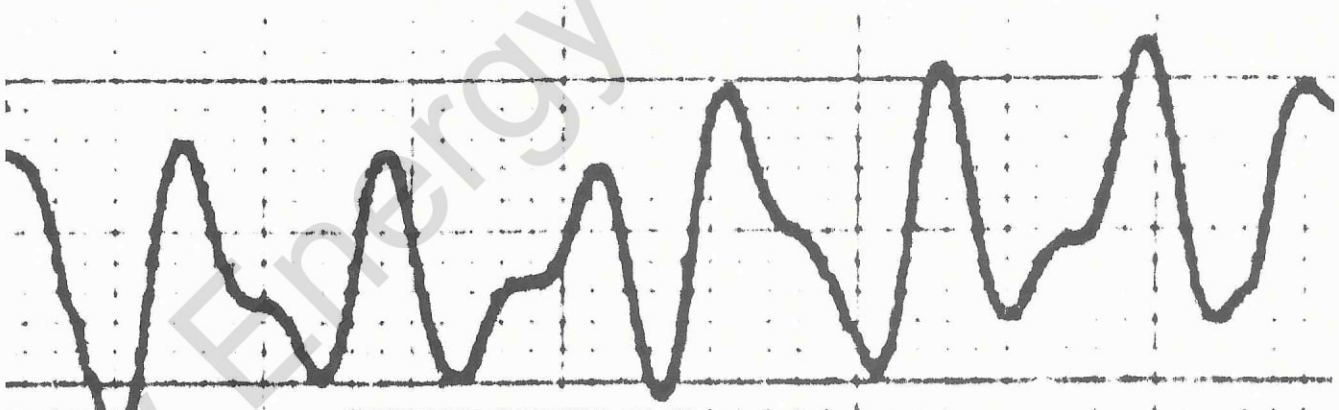
We then hypothesized that if free-fall was not a smooth process, then the induced gravity theory would predict (because of the general omnidirectionality of the external particle flux) that non-smooth behavior would also characterize motion in the x and y directions, observable in the microdomain. To test this conjecture, we examined carefully the laser intensity signal incident upon the light detecting diode, associated with the two-pendula system data given in Figure 2, in the region of the motion of the *lower*-mass pendulum near the position of minimum gravitational potential energy. This motion thus approximated the x direction of the xz plane through which the pendulum swings. Typical data from the current output of the light detecting diode for this near-horizontal (near tangent) region are given in Figure 7b. Inspection of these data show a random-type modulation of the signal (horizontal regions near the center of a cycle of the signal) suggestive of a non-smooth micromotion in the x-direction, as well as what we observed in the z direction for free-fall.

To further test whether there is a non-smooth non-monotonic behavior in the free fall of water, we employed the use of a van de Graaff generator to deflect the otherwise free-falling water droplets, very similar to the technique given in Reference 10. Figure 8 gives a digital frame of a camcorder video tape recording of the deflection of a single water droplet due to the positive charge on the van de Graaff generator dome, thus the path of the water droplet when subjected to the combination of a gravitational and to an electrostatic force. The video recording was taken at 30 frames per second, at conditions whereby the droplet would be suspended at the tip of a burette, owing to the high surface tension of water, were it not for the potential on the van de Graaff generator dome. The photograph in Figure 8 (and the drawing in the inset) shows a zigzag trajectory of the single droplet as recorded by time-lapsed photography (rather than a purely diagonally directed trajectory). These data seem to suggest that the fall is *not* smooth and continuous, and that either the gravitational component of the combined forces, or the electrostatic component (or both components), is/are contributing a basic phenomena that creates "jumps." Based on the collimated neutron experiment of Reference 14, it seems that at least the gravitational component of the force is associated with an effect that is non-classical.

Other Considerations

Measurements of G

The anomalous effects reported by others regarding the change in period of a Foucault or torsion pendulum, and the change in G as a function of temperature (over a 200 degree



This signal refers to the output of the light-detecting diode (amplified many times) versus time (two large blocks correspond to 1 cm of chart recorder and represent 2 seconds) to accentuate the behavior when the motion of the pendula is in the neighborhood of their minimum potential energy, and best approximate motion in the x-y plane [note how the trace in this region shown by the almost-horizontal sections of the signal (in mid-cycle) are not smoothly harmonic and appear modulated, but occur seemingly at random, suggesting non-smooth behavior of motion in the x-y plane as well as what was previously suggested for the z-direction].

Figure 7b. Output signal of light detecting diode based on incident/scattered laser light related to the motion of the lower-mass pendulum (in the two pendula system) near the position of minimum potential energy (low point in path of pendulum). Note the irregular non-uniform wave train and the horizontal (modulation) part of the trace occurring randomly in mid-cycle.

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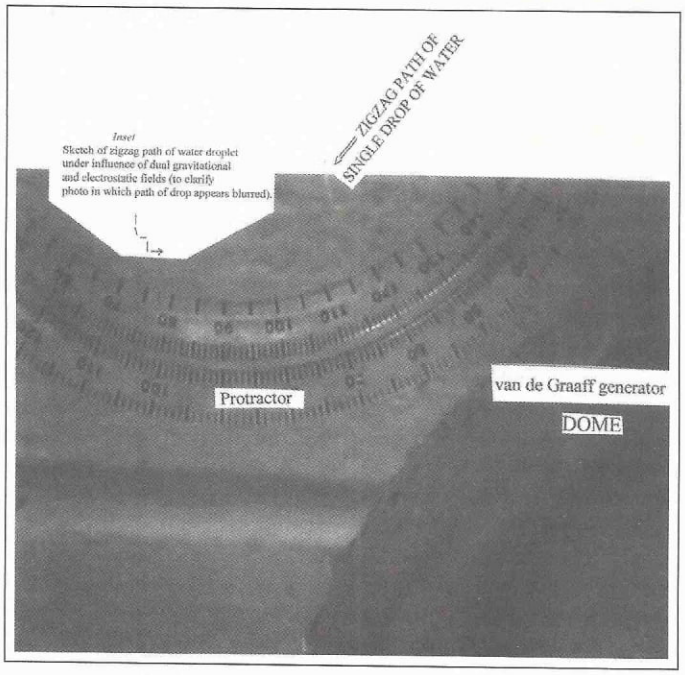

Figure 8. Single frame digital photo from camcorder video tape (30 frames per second) of a single droplet of water being deflected by the positive charge potential on the dome of a van de Graaff generator (shown in the lower right of the photo). Note the zigzag pattern of the path of the water droplet. See inset for drawing of the zigzag path.

centigrade range; References 8 and 9) are of the order of 0.05 to 0.01%. Although our syzygy data were taken on an offset scale, from calibration studies, the maximum decrease in gravity during the 35 sec duration measured event was of the order of 0.01%. Very recently, Mikhail Gersteyn[18] reported that G is *not* a constant and varies 0.054% depending upon orientation of the two gravitating bodies relative to a system of fixed stars. Our theoretical work[15] indicates that what was given as the universal gravitation constant, G, in Newton's formulation, appears to be a function that depends upon the collision cross-section of external particles and nucleons. Our own work on studying G as a function of temperature,[10] shape,[10,19] and phase[10,19] indicated a variation effect of the order of .0.04 - 0.05%.

Very precise measurement of Newton's constant, using a torsion balance with angular acceleration feedback have been accomplished by Gundlach and Merkowitz.[20] The authors point out that unlike most other physical constants, the value of G is not precisely known due to the weakness and nonshieldability of gravity, and that since the time of the measurement by Cavendish, the uncertainty in G has only been reduced by a factor of about ten per century. In the past decade all measurements of G have error bars that are larger than those of the accepted value of G, that was reported by Luther and Tower.[21] Our current work would suggest that G in this region of the universe varies minutely with many factors that have been described herein, and as such, the variation in the diverse measurements of G from year to year are not unreasonable. G then appears to have some dependence upon the probability for a graviton- nucleon inelastic collision and to a lesser degree the probably for an elastic collision, and as such, one must take into account the variation in the graviton particle flux at a given time (such as due to a supernova explosion somewhere in the universe about five per century in our galaxy), and alteration of the conditions to which the nucleon is exposed. It also seems apparent that a graviton-proton inelastic collision will be somewhat different than a graviton-neutron inelastic collision, relative to the collision-induced (shadowing) theory of gravity. The equation (Reference 15, Equation 34) that we developed to describe gravitational interactions (in terms of dp/dt) parallels the Newtonian expression, however the mM product term is replaced by a probability-for-collision comparable term, and the inverse square central force dependence term is replaced with the inverse square flux-dependence.

It is noted that an extremely large body of observations are in excellent agreement with Newtonian gravity (with small relativistic corrections), such as the orbits of the moon, Earth, and the planets. These data have argued strongly for the Newtonian model, however, the results reported herein do *not* refer to the Earth taken as a whole, but only to the local region in the vicinity of the measuring laboratory where line-up is achieved. The same is true for the data of others that relate to total solar eclipses. For general

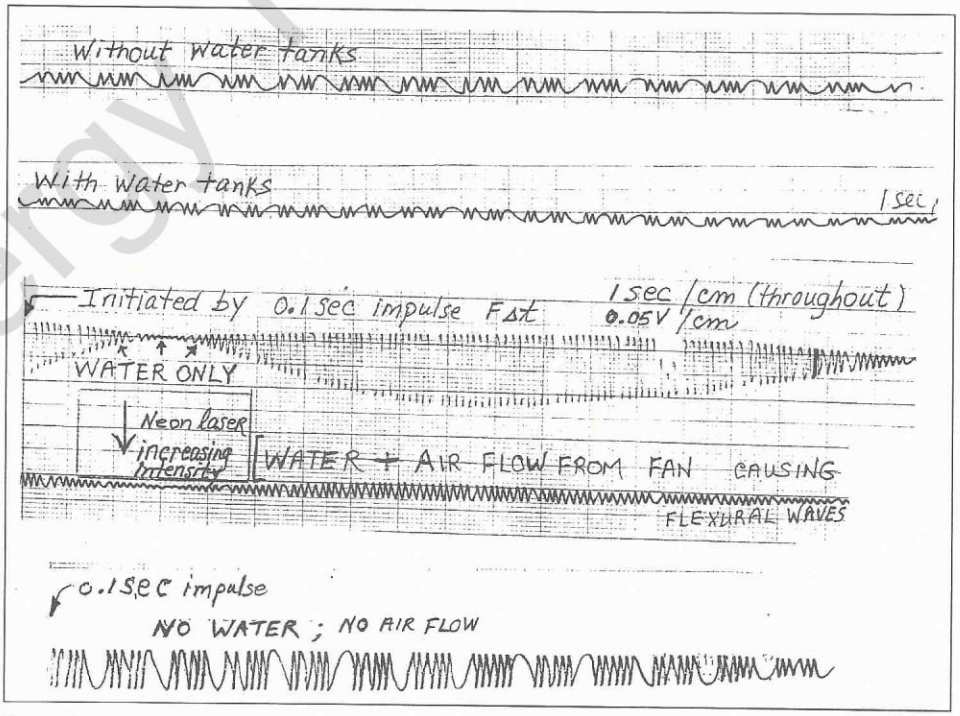

Figure 9. Wave train signature characteristic of a magnetic pendulum oscillating in both a gravitational and reverse magnetic field (z-direction), showing the change in the signature due to the presence of water tanks (with and without air coupling to the water; the pendulum was baffled from any air convective currents due to the fan which on occasions coupled flexural waves to the surface of the water). Signal corresponds to the output current of the light detecting diode upon which scattered laser light incident upon the magnetic pendulum (from grazing off the circumferential region of the cylindrical magnet) at the extremity of the suspension fiber.

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validity, a gravity model must explain local as well as far-field data and events. The gravity model that we have advanced[15,19] devotes special attention to the electron neutrino as a possible candidate for the external particle (graviton). The electron neutrino has the low energy of about 1.6 eV, and the required very low collision cross-section of about 10^{-38} cm^2. The neutrino has also been proven in the Super K experiments to have mass, and propagates essentially at the velocity of light. It is also being explored whether the muon neutrino, emanating from the Sun, is the influencing external particle related to the radioactive decay anomalies and unique histograms discussed earlier (thus relating to the weak force).

Magnetic Pendulum Data

In order to investigate any indication that electromagnetism is also affected by external particles (such as the tau neutrino, the magnetic moment of which is larger than that of the electron neutrino or the muon neutrino) we utilized a magnetic pendulum (squat cylindrical cobalt-samarium magnet that was suspended from a non-magnetic fiber, moving in the field of a reverse polarity identical fixed magnet). The laser incidence/scattering signal that was associated with the motion of a single magnetic pendulum, under the influence of an opposite polarity fixed similar magnet in the z direction, and under the influence of gravity is given in Figure 9. The wave train is considerably different from the data of Figure 2, which was not influenced by any magnetic material. We wished to test whether a perturbation in the x-y plane would affect the signal detected by the light detecting diode. To do so we placed two 10 liter glass tanks filled with water in the x-y plane (+x-direction). The data in Figure 9 show a significant change in the magnetic pendulum oscillatory behavior when the 10 liter tanks of water are inserted into the experiment. We interpret this as suggestion that further study should be conducted of external particles affecting electromagnetic phenomena. We postulate that such a study will eventually lead to determining that the interaction of the total momentum of external particles with the total momentum of what are referred to as charged particles (proton and electron) is the governing fundamental phenomenon rather than charge itself which is better viewed as a paradigm.[22] (Some persons report inconsistencies between Maxwell's equations and Ampere's original experiments, which may be explicable in the above terms).

Conclusions and Inferences from Syzygy Data

From this and related studies, we conclude that local gravitational effects taken during eclipse and syzygy are *not* explicable via a time-independent Newtonian model for gravity. Although our syzygy results are in accord with the measurements of others showing gravitational anomalies during total solar eclipses, it is not conclusive that the syzygy measurements are due to exactly the same phenomenon as the eclipse data; in the case of the eclipse, the Sun is blocked (shadowed), thereby removing some source particles which could otherwise transfer momenta and causing gravitational interactions, but instead the syzygy event is also associated with the Sun, Jupiter, and Saturn blocking particles the origin of which are from deep space. We also infer from our work that the source of gravity is at times influenced by random effects that also may be associated with deep space events. Data on the precise diurnal variation of a Foucault pendulum would be helpful in resolving the explanation of the total eclipse effect. We also conclude from this study that radioactive decay data are influenced by cosmophysical events.

Conclusions and Inferences Regarding Inverse Square Gravitational Relationship

The experimental results given in Reference 12 indicate that the inverse square dependence of gravitational interactions persists down to ~0.2 mm. More recent work, taken at ~0.1 mm length scale, but not using a pendulum apparatus, reported no contribution from extra dimensions in resonant frequency coupled measurements aimed at gravitational studies.[23] Our two-pendulum data ~0.1 mm short length scale data[11] suggested contributed gravitational effects that were not commensurate with inverse square behavior but in better accord with inverse fourth dependence. In terms of collision-induced gravity, any departure from inverse square dependence suggests a gravitational behavior not associated with the normal flux (such as interference or reflection effects) from a point source. Inside a gravitating body, such as considering the electron and proton within, the hydrogen atom is not addressable by conventional Newtonian theory. In the collision-induced gravity model, the presence of a problematic singularity does *not* appear because the distance parameter associated with the inverse square arising from a point source which gives rise to divergence when approaching zero is not applicable.

Acknowledgments

The author wishes to acknowledge consultations with Dr. John Gedye of Zygotron Corporation, Frank Lucatelli of HEAR, and Dr. William Stanley of Parametrics Technology Corporation. Gratitude is also extended to Professor Larry Rubin of the Massachusetts Institute of Technology for the loan of precision measuring equipment, and to Carolyn Ryan, Andrew Magliozzi, Elissa Langley, Matthew Pooley, Nevi Kosa, Diana Nemirovsky, Matthew Sullivan, Christopher Ng, Zachary Lee, Jeff Tham, and Maxwell Felsher for laboratory assistance. Appreciation is also extended to Dr. Derek-Lane Smith of Durridge Corporation and Professor Chuck Blatchley of Pittsburgh State University for consultation and assistance in radioactivity work.

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22. If indeed what has been conventionally referred to as the electromagnetic force is unambiguously associated with an external particle (such as the tau neutrino), then together with the external gravity bearing particle (graviton) and the external weak-force-influencing particle (perhaps the muon neutrino), these three particles and their interactions with mass particles such as nucleons or charge particles such as electrons should be construed as fundamental phenomena instead of the enigmatic terms "force" and "field." Further work should be conducted to clarify the fundamental phenomenon causing what is referred to as the strong force. Two further implications of collision-induced gravity by external particles are apparent: 1) space can be described as Euclidean or Cartesian, but the trajectory or path of mass (including photons) through space is curvilinear (Riemannian) as predicted by Einstein; 2) the relativistic mass transformation is merely a mathematical manipulation, but has no validity in physical nature.
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About the Author

Dr. Gary Christopher Vezzoli received his B.S. in physics from Fordham University, M.S. in geophysics from Boston College, and Ph.D. in solid-state science from Pennsylvania State University. As a research physicist and university professor he has authored over one hundred papers published in scientific journals of physics and chemistry. Recently, Dr. Vezzoli has turned his attention to biophysics and the life sciences, from which some of the research that is described in this article has been derived in studies that he has conducted at the Franklin Institute and at Harvard's Farlow Herbarium. The water research in conjunction with his gravity studies has led him into current research in preventing birth defects in the very early stages of pregnancy. In 1998, while teaching physics and chemistry, Dr. Vezzoli was awarded the research project Mentor of the Year Award in the state of Massachusetts.

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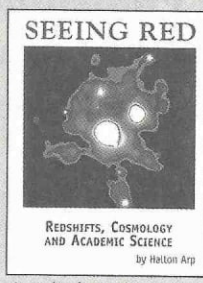

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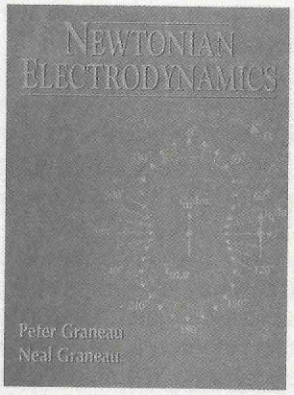

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Why We Are Publishing Eugene Sittampalam's "Cosmic Microwave Background and the Unification of Physics"

Eugene F. Mallove

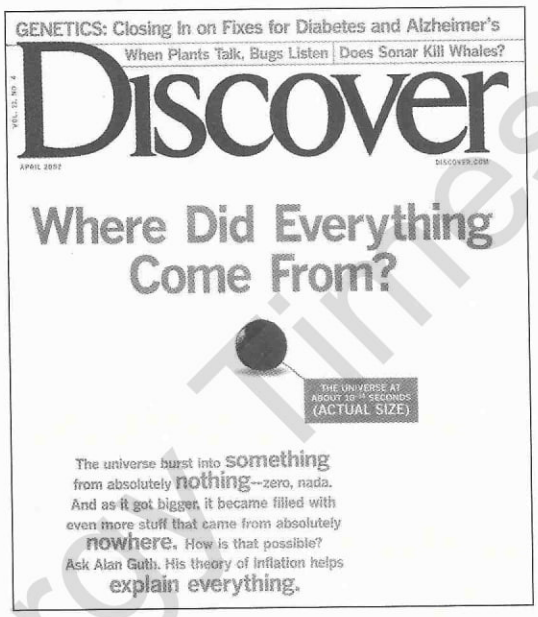
The first time that I heard anything about engineer Eugene Sittampalam and his physics and astrophysical theories was at a special session on cold fusion/low-energy nuclear reactions at an American Physical Society (APS) meeting in Washington, DC, April 30, 2001. These cold fusion sessions have been tolerated for some years now by the APS, which is regularly abusive to cold fusion research in so many ways. For some reason, Mr. Sittampalam's presentation, boldly titled "Theory of Everything," had been put on the program in the cold fusion session, perhaps because the APS apparently finds it difficult to distinguish one variety of what it deems to be "crank physics" from another. In Mr. Sittampalam's case, the author was putting forth a radical theory that would challenge Einstein's Special Relativity Theory (SRT) and much else.

In his ten to twelve minutes of allotted time, he had valiantly tried to compress the content of his thirteen-page handout, which summarized his larger opus—a book-length work titled simply, *Theory of Everything*. What was most interesting and remarkable about his lively talk was that it appeared to be presenting an alternative to SRT that was based on what looked like an "engineer's view" of the problems posed by Relativity; it offered some provocative simplifying formalisms that he claimed led to an overarching cosmic theory. Sittampalam was kind enough to give me at that time a bound volume of his larger work, which I would later study from time to time as I reviewed papers by many other investigators who had been critical of Einsteinian relativity. This happened at the time that *Infinite Energy's* two consecutive "Einstein Reconsidered" issues (#38 and #39) were being assembled.

About a year later, we received our copy of the April 2002 issue of *Discover* magazine, and there on its cover was what you might call an artistic rendering of the Establishment's "Theory of Everything." The cover featured a picture of a large red marble on a white background, with a label attached to the marble: "The Universe at about 10^{-34} seconds (ACTUAL SIZE)." I measured that red marble, representing the supposed infant version of all our existence today (the entire plenum of space-time, all mass, and all energy); it was 2.0 centimeters in diameter. *Discover's* descriptive cover text about this provocative image: "Where Did Everything Come From? [red marble] The universe burst into something from absolutely nothing—zero, nada. And as it got bigger, it became filled with even more stuff that came from absolutely nowhere. How is that possible? Ask Alan Guth. His theory of inflation helps explain everything."

With that as an introduction, I paged through to Guth's article. Yes, there was the MIT "whiz kid," whom I had known personally when I was at MIT from 1987 to 1991, the man who many say is destined to win a Nobel Prize for his theory of cosmic "inflation," wherein many of the Big Bang's nasty problems are said to be abolished by elegant mathematical slight-of-hand. Brad Lemley, author of the Guth piece gushed: "Guth's theory of inflation—the name he coined for this superfast early-universe expansion—has since vanquished every theoretical challenge and grown stronger with each new cosmological finding, including the latest, largest one: that the universe's expansion rate, long thought to be slowing, is actually accelerating." Now that's a tough act to follow—a Big Banger who's got it all figured out!

But lo and behold! Right there on page 67 of that very issue of *Discover* appears the face of—you guessed it—Eugene Sittampalam! (His full given name is Simon Eugene, but he goes by Eugene.) Unfortunately for Sittampalam, the coverage of his theory is by no means adulatory. In fact, it is downright insulting. Yet it suggests a slight degree of wonderment that this soft-spoken engineer from the less-developed world has somehow put together a clever theory that *seems* to make many correct predictions. The article, "Notes from a Parallel World," by Jennifer Kahn concerns "cranks" in physics, specifically those whose works are being compiled and studied at the University of California at Berkeley by physicist Richard Muller. (I wonder if they collect cold fusion/LENR papers there too?) Muller terms his collectibles "crankiana." And, indeed there are true "cranks" within that collection—people who write incoherently or who blend their science with certain kinds of inappropriate appeals to political or religious matters.



Kahn's article begins the tale of these "crank" physics theories with the story of how Sittampalam, who is a native of Sri Lanka, came upon his grand ideas when he was in Libya—about 1991, while on a consulting engineering project. But before that account, we are told by the *Discover* headline-makers what we should think of people such as Sittampalam, whose treatises find their way to such wise elders as Muller of Berkeley: "Inside the X-files at the University of California at Berkeley, the line between theory and fantasy, science and supposition, starts to dissolve. The authors of these dissertations are obsessed—and scientists are nearly as obsessed with them." In other words, these are freaks, whose intellectual output is not to be taken seriously, because—of course—it just *has* to be wrong in all its particulars. What, question the *foundations* of physics and not simply propose new floors to the giant air castle? Unthinkable! Guth, the man with the 2-centimeter universe, is serious, but Sittampalam, who questions the fundamentals of physics, is not.

Journalist Kahn submitted Sittampalam's treatise to an

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anonymous physicist for review, she says. She confided to her readers that she hoped that her secret physicist would either find an egregious error, or perhaps some worthy new truth! Here was the reviewer's actual reaction, as told by Kahn: "As I read this, I kept thinking: 'How hard can it be to prove that this paper is incontrovertibly wrong?' But it is hard, not because his ideas are right. They're not. But because he's created a self-consistent system of arguments." Well, that interesting Establishment review and the attendant disparagement of Sittampalam's ideas was almost enough reason for me to decide to present his views to *Infinite Energy's* audience, but not quite. What pushed me to publish his paper are two factors: A) Sittampalam submitted this paper to *Physical Review D*, and it was rejected out of hand—in other words, "sneer review" at work, the same modus that keeps all manner of worthy heretical physics out of the exalted "Phys Rev."; and B) Though I doubt that Sittampalam's physics can be applied readily to explain any or all of the anomalies in new energy experiments that are being found, his theory is an excellent illustration of how an apparently consistent framework can be constructed to counter prevailing physics. That itself should be sufficient warning to put the Physics Establishment on notice that it could well be promulgating layers of mathematical mysticism, and not truth about nature. There is a simplicity about Sittampalam's theory that is refreshing. It may well be wrong in whole or in parts, but there could also be points of agreement with other emerging physics theories that bear on the localized nature of the photon and on the existence of a cosmic ether.

Aware of the heretical nature of that very word—ether—Sittampalam holds off until near the end of his paper, where he remarks: "The final theory propounded here is not something that is entirely new. In fact, it is reminiscent of the old 'ether' theory. (In a way, this work is a tribute to the proponents of that theory of over a century ago—their intuition and gut feeling from everyday experience were not wrong after all!). . .The classical vacuum is the ether in its 'evaporated' state; classical matter is the very same ether material in 'condensed' form; and the ether itself is indeed mass-energy."

A few comments about Eugene Sittampalam, the man. He resides in Sri Lanka, his country of origin, but has traveled the world as a consulting engineer. He graduated with a B.Sc. in Engineering in 1969 from the University of Ceylon (affiliated with the University of London, England). Most of his career has been spent working overseas as an engineer-consultant for large corporations. In the 2001-2002 timeframe, when the furor over his theory erupted, he was apparently working for the corporation, ElectroFlow Lanka Ltd., which deals with energy conservation for power-intensive industries. Sittampalam is articulate, polite, soft-spoken, and quite willing to address intelligent criticism openly. Yes, he is perhaps inordinately convinced that his theory is substantially correct, but he listens to criticism—whereas Establishment Physics tolerates no criticism whatsoever when its fundamental pillars are questioned. Would that the world of science were such today that instead the views of such a person would be welcomed and could be given a chance to compete with what passes for sacrosanct theory! Publishing his work, after *Physical Review* failed to do so for inappropriate reasons, is *Infinite Energy's* small contribution to allowing the free-flow of ideas to a receptive—and, we hope, an appreciative—audience. Perhaps some ripples of progress in understanding the true nature of the cosmos will come from this exposition. ❐❐❐

Sittampalam's Cover Letter

We print the following cover letter which Eugene Sittampalam submitted to *Physical Review D*, since it gives a good general outline of the theory presented by Eugene Sittampalam. Accompanying the cover letter is a telling quote from *Discover* about Sittampalam's work: "The problem that occupied him has stumped physicists from Albert Einstein to Stephen Hawking: How to join together the profound yet disparate insights of general relativity and quantum theory. But Sittampalam's doodling, apparently, drew connections that the rest had missed. 'I found myself getting really angry,' one cosmologist said after reading his paper. 'It must have hit some real insecurity.'" (April 2002, pp. 66-71.)

Dear Editor-in-Chief:

I am submitting herewith a breakthrough paper for your kind consideration for publication in your esteemed journal.

The paper is based on hard and well-verified facts of observation. Not surprisingly, the final theory of our observable world is indeed an extremely simple one. In a nutshell: The photon is the evaporated state of matter (mass-energy) and the atom, the condensed form; and all of fundamental physics—from the atomic to the cosmic—becomes classical mechanical in scope and high school stuff in comprehension. (It is as envisioned by Prof. Stephen Hawking in the concluding lines of his famous book, *A Brief History of Time*: "However, if we do discover a complete theory, it should in time be understandable in broad principle by everyone, not just a few scientists. . .")

In the overwhelming new light since the time of Einstein, we now have, for instance, an embarrassingly simple and classical mechanical explanation for the Michelson-Morley experiment. What need have we any more for the abstract? Please, therefore, be good enough to read the entire script yourself first, since this is science history in the making! Also, should any of your learned reviewers rule negative, do kindly request of them just *one* down-to-earth reason for their decision, since philosophical arguments in the abstract will never find resolution in physics.

In particular, they may comment on Section 5 of the paper, "The Vacuum Energy Field and the Contraction of Moving Bodies," and the derivation therein of the Lorentz-Fitzgerald Contraction Factor—now for the very first time from first principles. This section will prove pivotal to physics today since it takes us from the Einsteinian world of make believe and back into the Newtonian world of our everyday experience. (It is more likely that reviewers here will find solutions even to their own research problems as a radical reawakening takes place across the board when our old notion of gravity—that this most ubiquitous force in nature springs from within matter with some mystical pulling or space-warping power—gets corrected.)

To build that solid and irrevocable foundation for this singular and all-embracing theory for all time, I have, in Section 2, drawn attention to, and elaborated on, the cosmic microwave background radiation. The flux, E_o, of this all-important isotropic energy directly relates to the minimum absolute pressure of the classical vacuum. If you will pardon my assertion here—the sooner we realize and accept this fundamental fact of the vacuum, the sooner will basic physics research be out of the woods. (Photons and neutrinos contribute to the absolute vacuum pressure, which is very much underestimated at present. This pressure is high within the halo of the galaxy; reaches a stupendous peak at the galactic center; and makes our present recourse to dark matter and black holes only a further embarrassment.)

The book that I authored is referenced in the paper as Sittampalam 1999. I shall rush to you, by courier, the number of copies that may be required in the review of the paper. (I could also send the copies directly to individual reviewers if I am given their postal addresses.)

Finally, the underlying and burning conviction for the work all along has been: The First Cause would not have had material or design constraints when it came to creating what we observe as our universe. One material entity alone would have sufficed, profusely tossed out with a spin. And, voila! We have nature.

I await your kind response. Thank you and best regards.

Yours sincerely,
Eugene Sittampalam

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The Cosmic Microwave Background and the Unification of Physics

Eugene Sittampalam*

Abstract

The root cause for many of the mysteries, controversies, and travails in fundamental physics is the haze that continues today in our concept of the basic photon. The description of the photon, an entity that cannot be any more basic to physics, still languishes in a world of ambiguity and paradox. Fortunately, the radiation field of the Cosmic Microwave Background now provides us with a convenient stage on which to model the true and final concept of the photon for all time. The words "true and final" are not used loosely at all here—since the concept readily leads to the total unification of physics and to the long-sought "Theory of Everything" [Sittampalam, 1999. *And Now, the Long-Awaited. . ."Theory of Everything"*]. Propounded here is this foundation for physics. On it has been built the singular and all-embracing theory that explains the working of our entire universe of observation—from the atomic to the cosmic—in the space and time of our everyday experience. We shall discover here a physics that thrives solely on causal chains, and a physics that reinstates the primacy of classical mechanics. One should not therefore be too surprised also to find that there is but one *and only one* fundamental particle of analysis for both mass and energy—the "per-cycle" quantum of the photon—and that this mass-energy custodian *alone* wields that fundamental and singular clout in nature, be it gravitational, electromagnetic, or nuclear.

1. Introduction

The night sky is not dark after all. NASA's Cosmic Background Explorer (COBE) satellite, launched into space in 1989, has testified overwhelmingly to the fact (Peebles 1993; Turner 1993). The sky is indeed suffused with a remarkably even glow of electromagnetic radiation throughout—day or night. The COBE satellite tells us, in other words, that isolated space is submerged in a long-range quantum energy field that is also highly isotropic and homogenized. As also confirmed by the COBE instruments, this radiation is in the microwave range and is now accordingly called the Cosmic Microwave Background, or the CMB. (If we were creatures with microwave vision, we would know no night!)

Here, in this eternal cosmic light, is seen the ultimate model for the photon with the consequences it entails for the rest of physics. We shall see the unification not only of the forces of nature but also of matter and energy in a *single* physical entity that has only been too well known to us. Though incredibly simple and straightforward, the concept, however, has remained unrealized to date.

2. The CMB and the Photon Concept

Imagine a space in complete isolation such as intergalactic space. . .far removed from all material objects. The CMB will be isotropic and homogeneous. The speed, c, and the effective overall wavelength, say, λ_o, of the CMB (see Subsection 2.1) will be the same in all directions with no preferred net movement of these microwave energy photons in any given direction (relative to distant objects).

Even this desolate vacuum of space being totally filled with energy, "empty space," would be a contradiction in terms in fundamental physics. In this voidless "vacuum" field, the CMB is thus the vacuum field energy.

It also follows that a photon can not bodily travel between two points even in the vacuum. Instead, the photon simply transmits its effect *vibrationally* through the fluid-like energy medium that is the vacuum. In principle, it is no different than the transmission of sound through a material medium. Thus, the photon has the vacuum energy field as its medium of propagation. (As we shall see in Section 3, the vacuum is indeed a fluid-like medium of energy where *every single frequency* of the electromagnetic spectrum is vibrantly present in all directions. It is the *intensity* of energy that determines whether that energy is detectable or not to our material instruments. For instance, in isolated space, only the intensity in the microwave range remains sufficient for detection. However, when light comes to us, say, from a star, the corresponding frequencies in the vacuum field are intensified along the line to cause the effect for their detection.)

The most important point of note here is that the photon has a *vibrational*, or a to-and-fro, motion at speed c—and *not* a motion that is solely unidirectional between source and observer.

And this simple insight into the quantum world leads readily to the derivation of, perhaps, the most famous equation in science, $E = mc^2$, and more!

2.1. The Flux of Cosmic Energy

Let us start our detailed investigation here with the speed-c radiation that we detect today as coming from deep space all around. Let the intensity of this cosmic energy be, say, E_o per unit area per unit time. This minimum background flux of E_o may be assumed a universal constant from the sheer isotropy that is measured of it. However, as measurements also show, E_o is not confined to the single wavelength of λ_o (introduced above). In fact, E_o spans a wide band of wavelengths. (See, for instance, Peebles 1993, pages 131-134, where the paragraph starts: "At wavelengths in the range of millimeters to centimeters, the extraterrestrial electromagnetic radiation background is dominated by an isotropic component, the cosmic

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background radiation, or CBR. The isotropy suggests the CBR is a sea of radiation that uniformly fills space. This would mean an observer in any other galaxy would see the same intensity of radiation, equally bright in all directions, consistent with the cosmological principle.")

Nevertheless, the *transferable physical effect* of E_o will simply be its momentum, say, P_o, which (as per Subsection 2.2) will be given by,

$$P_o = E_o/c \tag{2.1}$$

Hence, in our analyses here, the wavelength λ_o would simply and conveniently represent the *equivalent* monochromatic photons having the same energy of E_o per unit area per unit time and thereby also the same momentum of P_o per unit area per unit time given by Equation (2.1).

It further follows that, if, say, e is the energy of *each* of these λ_o-wavelength photons, then the number density (or particle density) of these analytical photons will be E_o/e per unit area per unit time.

Hence, in analyses, the cosmic background energy may be equivalently considered as a constant stream of monochromatic photons with the following characteristics:

(a) Wavelength of photon $= \lambda_o$
(b) Energy of photon $= e$
(c) Energy intensity of photons $= E_o$ per unit area per unit time
(d) Number density of photons $= E_o/e$ per unit area per unit time

Further, λ_o, being in the microwave range, the term CMB, too, may be used to equivalently refer to the entire isotropic constituents that make up E_o. (In Section 3, we shall see that this isotropic and minimal E_o is indeed composed of the complete spectrum of speed-c radiation which in fact pervade cosmic space; and in Section 4, the role of E_o in the gravitational effect.)

Now, as per classical mechanical theory: 1) pressure is force per unit area and 2) force is momentum change per unit time. Combining 1) and 2), we will have: pressure is momentum change per unit area per unit time. Hence, if P_o is the momentum of E_o, and A_o is the (absolute) pressure of this cosmic flux, then,

$$A_o = 2P_o \tag{2.2}$$

since the (vectorial) momentum change that causes pressure on a surface is $2P_o$ in magnitude, that is, P_o on impact plus another P_o on recoil from surface.

Hence, from Equations (2.1) and (2.2), the *minimum absolute pressure*, A_o, of the classical vacuum of space will be given by,

$$A_o = 2E_o/c \tag{2.3}$$

Thus, as we shall see in Section 3, A_o is the minimum absolute pressure whose constituent "partial pressures" at the various levels of the atom keep matter in existence in nature. In other words, it is the simple classical mechanical pressure A_o caused by the momentum exchange in the condensation (impact) and evaporation (recoil) of the ubiquitous flux of E_o that keeps even the atomic nucleus in statistical equilibrium with its ambient field.

2.2. The Equivalence of Mass and Energy

A reflector of the CMB energy would feel a constant ticking of the photons as if they were some form of matter particles striking it at space intervals of λ_o, or time intervals of $t_o = \lambda_o/c$. And here's another important point of note. Though each seeming particle bombarding the reflector comes in at velocity c, the selfsame particle's net displacement over the period t_o would remain zero since no net movement of energy takes place in the given space. In other words, each particle would have a to-and-fro motion within a length of $\lambda_o/2$ with zero net displacement over t_o.

The photon is eternal. It is absolutely indefatigable. It may take billions of years for (the effect of) the CMB photon particle to reach us from the far cosmos; but once it's arrived, its energy would be found to be no different than that of a photon particle that comes a-ticking at the same frequency from a local source.

Analytically, therefore, the CMB photons—in fact, photons in general—may be considered as perfectly elastic particles with mass, energy, and volume. Perfectly elastic particles, as we know, conserve energy (and mass) individually and absolutely. They do not give out or take on energy in any interactions. The particle energy can only get transformed between kinetic and potential within the particle, the energy thus remaining intrinsic and nontransferable. When two such identical particles collide, say, head-on, the velocity of each particle drops from c to zero, momentarily, and reverts to the same magnitude of c in the opposite direction. Thus, the particle energy switches totally from kinetic to potential and back to kinetic again. And it is momentum—*and momentum alone*—that gets transferred between particles in any and all interactions.

The CMB photon is thus a perfectly elastic particle, fully and forever resilient. Let its energy be e and mass m. (Yes, let us here be rid of any preconceptions from partial theories such as special relativity where it is argued that the photon cannot have a mass, that is, a so-called rest mass; if that's difficult, let's consider m as that theory's "inertial mass.")

Hence, the single CMB photon has energy e, mass m, velocity c, wavelength λ_o, vibrational length $\lambda_o/2$, vibrational period λ_o/c, and momentum change from a vibrational impact 2mc (that is, reckoned vectorially, a change of mc at impact plus another change of mc at recoil).

In classical mechanics,

energy = work done
= force x distance
= pressure x area x distance
= pressure x volume

Hence, for the vibrant particle of the CMB field,

energy = pressure x vibrational volume
= (force/vibrational area) x vibrational volume
= force x vibrational length
= rate of momentum change x vibrational length

That is,

$$e = [2mc / (\lambda_o/c)] \times (\lambda_o/2)$$

or,

$$e = 2mc \times (c/\lambda_o) \times (\lambda_o/2) \tag{2.4}$$

Whence, from Equation (2.4),

$$e = mc^2 \tag{2.5}$$

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Get the physical model right, and the physics of nature turns embarrassingly simple! We have the first glimpse of this fact in the above derivation of the famous equation in science (expressed here as $e = mc^2$)—for the very first time from first principles. (For derivation of the equation using Einstein's special relativity, see, for instance, Born 1965, pp. 278–280.)

As we shall also see in Section 3, mass and energy are intrinsic not only to the photon but also to matter—the latter being just the condensed form of the former! And since c is an absolute constant (in the "rest" frame of the CMB; Section 5), the classical concepts of mass and energy may now be merged as one by virtue of Equation (2.5). Mass and energy, therefore, will now refer to one and the same parameter of measure in fundamental physics. Let's call it *mass-energy*. We may still use the terms "mass" and "energy" in our analyses as long as we know the two are not fundamentally distinct entities, like space and time.

Now, momentum is mass times velocity. Therefore, if p is the momentum of the single CMB photon, then,

$$p = mc \tag{2.6}$$

From Equations (2.5) and (2.6), we will then have,

$$p = e/c \tag{2.7}$$

which is another well-established empirical formula in quantum physics.

2.3. Planck's Law

The quantum e and wavelength λ_o correspond to the absolute minimum amount of detectable energy in the universe. That is, *nothing less may be detected by any physical means* in the desolate vacuum field or elsewhere. Now, just for ease of reference hereinafter, let us call this single photon particle of absolute minimum energy the *radiaton* (pronounced: radiate-on!).

Hence, a detector in isolated space will, in effect, receive radiatons at spatial intervals of λ_o, or time intervals of $t_o = \lambda_o/c$, or frequency $f_o = 1/t_o = c/\lambda_o$. (Note that each of these radiatons is the single CMB photon of energy e.) Therefore, as observations confirm, all other photons may be considered as just integer multiples of e carried within the length of λ_o. And all these higher energy photons (generally absent for detection in isolated space) will require their own sources to originate from. (Again, as we shall see in Section 3, every single wavelength of energy is indeed vibrantly present even in the vacuum of isolated space, but it is intensity that determines if that energy is detectable or not, that is, to material instruments.)

Thus, from an external source, the next photon energy, which is 2e, or two radiatons, will be received by the detector only at the statistical wavelength of $\lambda_o/2$, or frequency $2f_o$. That is, in effect, from source to detector, an extra radiaton will be transported within the spatial interval of λ_o; and, statistically, the extra radiaton will be evenly spaced within λ_o. The next photon energy, 3e, will be similarly received at frequency $3f_o$ (or two extra radiatons evenly spaced within λ_o), and so on.

This shows the photon energy to vary linearly as its detected frequency. In other words, the photon's energy, say, E, is directly proportional to its detected frequency, say, f; or,

$$E = hf \tag{2.8}$$

where h is the constant of proportionality.

This is the law of the radiation field that was first postulated by Max Planck in 1900. It is derived here for the very first time from first principles.

Thus, E is a simple multiple of e; f is the frequency of the e-energy particles, or radiatons, in the "train" of length λ_o carrying the single E-energy photon; and h, the constant of proportionality, is also known as the Planck constant.

Analytically, therefore, all single photons have the same length of λ_o in the direction of radiation; the energy of the photon is represented by the number of its constituent radiatons carried within the length λ_o; and the frequency, f, and wavelength, λ, of the photon correspond to these speed-c radiatons being evenly spaced within the length of λ_o. *The radiaton is thus the "per-cycle" particle of the photon*, in general. (The transverse disturbance in the vacuum field gives the photon its wavelike nature; see Sittampalam 2003, Two-Slit Tests.)

On the other hand, wavelengths longer than λ_o registered by detectors are, in reality, pulses of (λ_o-length) photons from the source. That is, they are intermittent emissions of energy, 2e or higher, pulsed through the ambient field at the detected (pulse) frequency. The pulsed photons thus "ride the crests" of the signal wave.

Typically, such a wave is the radio signal and is emitted by the electron as it oscillates between two orbital energy levels of the atom: The electron becomes more in energy content at the higher radial level, having been boosted to the level by the absorption of a photon; its orbital frequency being no longer synchronous with the breathing cycle of the atomic nucleus, the electron finds it unstable at this so-called excited level; as a result, the electron spontaneously drops back to its stable ground level; as the electron thus descends into an ambient of increased asymmetry (brought about by the closer proximity of the nucleus), the energy it gained gets "squeezed" out; and the cycle of quantum leap and quantum fall back repeats, conditions permitting. (Descriptions of the electron's orbital cycle and the excited state are given, respectively, in Sittampalam 1999, Sections 5.06 and 5.07.)

λ_o now assumes great significance as also the "photonic length." It is the reference length on which all the photons of the electromagnetic radiation spectrum are based. Further, λ_o gives a physical meaning to Planck's constant, h, for the very first time, as we shall also see next.

3. The CMB and the Atom

The central failure of classical mechanics, it is often said, is its inability to account for the structure of the atom. That is, until now.

3.1. The Force Field of the Atom

Equation (2.8) expresses Planck's law. It simply tells us: "Photon energy equals a constant times cycles per unit time period." Transposing it, we will have: "Photon energy per cycle equals a constant per unit time period." In other words, the energy per cycle of the photon is an absolute constant. This absolute per-cycle energy quantum, or particle, is the radiaton (see Subsection 2.3, above). The radiaton is thus (detectably) the most basic constituent of any photon of the electromagnetic spectrum.

Consider two single radiatons. In a head-on collision with one another, the momentum of each particle changes from mc in one direction to mc in the opposite direction. Any

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momentum change for an inertial body, though, takes place not instantaneously but over a finite period of time. The radiaton momentum will thus change from mc, through zero, and back to mc again during a nonzero time interval. However, should the next encounter take place before the lapse of this period, the radiaton would be found lacking in "clout," not having regained its full momentum of mc.

The force field of such a region, that is, of very short wavelengths, will thus remain subdued. The equatorial diameter λ_n of nucleons and electrons exhibits this critical wavelength below which the radiatons continue to be vibrant only at sub-c speeds, that is, within the subatomic particle. At the surface of the subatomic particle, the radiatons just attain the wavelength λ_n with speed c at their vibrational midpoints. (Surface speed is maximum at the equator of the spin particle; the critical diameter λ_n is thus maintained at the equator as the particle expands and contracts along the polar axis over its breathing cycle; see Sittampalam 1999, Section 2.06.)

Thus, within the atomic nucleus, the radiaton exerts less force as a consequence of its sub-c speed, compared to the force it would exert at the nuclear surface, that is, at speed c. (In fact, the force field attains a universal maximum at the nuclear surface; see Sittampalam 1999, Sections 2.08 and 2.09.) As a result, the radiaton energy remains considerably dormant within the atomic nucleus. The energy release in a nuclear reaction is but the partial venting of such entrapped radiatons out into free space. (Note: It is purely for the purpose of theoretical analysis that the radiaton is considered here to remain a discrete entity even within the atomic nucleus. However, in reality, the atomic nucleus need not contain its energy as individual radiatons even though the speed-c energy it releases comes out detectably in that form. An analogy to this is seen in the macroscopic world: Water does not exist as discrete drops in the pipeline although it emerges as such from a leaky faucet.)

3.2. The States of Mass-Energy

Hence, analytically, only at the nuclear surface do the radiatons just attain speed c and can evaporate off. Ambient radiatons, on the other hand, can lose their speed c at the nuclear surface and condense into the nucleus. At steady state, these two processes become balanced. (Note: It is the spin of the subatomic particle that knocks the ambient radiatons and entraps them inside in net over a half cycle; see Sittampalam 2003, The Spin.)

In this perspective, it is plainly seen that *the photon is but the evaporated state of matter, or mass-energy, and nucleons and electrons the condensed form.* Further, even the vacuum being totally filled with the photons of the cosmos, *our universe of observation is but a seamless and voidless continuum in mass-energy.* (Strictly, neutrinos contribute equally to the evaporated form. This is taken up in Section 6. Sittampalam 1999, Section 2.06, explains how a nonvanishing seminal spin in this continuum maintains an overall balance between the evaporated and condensed phases of mass-energy in our universe.)

3.3. The Atom as Seen by the Photon

It also now becomes a simple exercise, as given in Sittampalam 1999, pages 37-43, to show (quantitatively) that the atom presents to the photon a body of diameter equal to the wavelength only of the photon itself. That is,

$$d_{atom} = \lambda_{photon} \tag{3.1}$$

In other words, in isolated space, for instance, where the wavelength of the ambient field is λ_o, the atom will have an effective diameter of λ_o. But, say, an X-ray photon of wavelength λ_x will be intercepted by the atom only at a depth corresponding to diameter λ_x of the atom.

3.4. The Communion of Atoms

Condensation and evaporation take place unceasingly at every (quantum) energy level of the atom. This breathing keeps the atom forever live even in its ground (or "unexcited") state. The exchange also keeps the atom in constant communion with the other atoms whether they be separated by Angstroms or light years across the vacuum field. That is, each energy level of the atom would be resonant with corresponding levels of the other atoms of the continuum. Thus, any two ground-state atoms at rest in an inertial frame would still be in contact by way of their minimal exchange of radiatons across the separating void. This necessitates, for consistency when all the atoms of the inertial system are considered, the simultaneous absorption followed by the simultaneous emission of radiatons. Hence, a pair of corresponding atomic levels would *always remain synchronous, in phase, and separated by an integer wavelength number* along their line of centers.

Furthermore, the atomic energy level is non-rigid. That is to say, energy is emitted not from a fixed point in the atom but from a highly resilient membrane-like stratum. Consequently, any adjustment to the distance separating the (imaginary) centers of two atoms would result only in full wavelength shifts between their corresponding energy levels.

An excited atomic level would emit detectable energy, the smallest quantum of which is the single photon characteristic of that level. A given photon of detection may thus originate only from a specific atomic energy level when excited; and this photon may now be absorbed only at a downstream atomic level that is resonant with the incoming energy. But, with both their atomic centers at rest in an inertial frame, these two levels will already be synchronous, in phase, and separated by integer wavelengths at the unexcited state itself. Thus, their ever-vibrant relationship gets only enhanced in the excited state. This state of communion is independent of the frame velocity and the orientation of the line of energy transfer with respect to that velocity. And with these renewed insights into the quantum world, the famous Michelson-Morley experiment of 1887 now finds a simple and straightforward explanation. It is the seemingly strange findings of this very experiment that set the stage for Einstein's theories. (A revisit to relativity in the renewed quantum light is made in Section 5.)

3.5. The Universal Force and Pressure Fields

Hydrogen is the basic atom and chemical element. Its nucleus is the single nucleon. Considering just the basic atom in isolated space, it can now be easily shown (Sittampalam 1999, Chapter 2) that:

(a) The absolute maximum force, F_{max}, in the universe occurs at the nuclear surface, and is given by,

$$F_{max} = mc^2/\lambda_n \tag{3.2}$$

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where m is the radiaton mass and λ_n is the equatorial diameter of the nucleon.

(b) The absolute minimum force, F_{min}, in the universe occurs in the vacuum of space, and is given by,

$$F_{min} = 2mc^2/\lambda_o \quad (3.3)$$

where λ_o is the CMB wavelength.

(c) Outside as well as inside the nucleus, the force field drops from F_{max} to F_{min}. That is, with decreasing atomic radius, the force field of the atom would increase from the low outside ambient value of F_{min} to peak at the nuclear surface at F_{max} and then drop back to F_{min} at the nuclear center.

(d) The F_{min} within the nucleus occurs inside a nonvanishing central sphere of diameter d_o given by,

$$d_o = 2\lambda_n^2/\lambda_o \quad (3.4)$$

(e) The Planck constant, h, is fundamentally a pure wave number, given by,

$$h = \lambda_o/\lambda_n \quad (3.5)$$

In other words, h is an integer, a number that simply tells us "how many times λ_n goes into λ_o." The physical significance of h is thus realized for the very first time in physics. [Note: λ_o is in the microwave range, or of the order of 10^{-3} m; λ_n is in the gamma-ray range, or of the order of 10^{-15} m; hence h (= λ_o/λ_n) will be of the order of $10^{-3}/10^{-15}$, or 10^{12}.]

From Equations (3.2), (3.3), and (3.5), we will then have,

$$F_{max}/F_{min} = h/2 \quad (3.6)$$

(f) The pressure on the nuclear surface is an absolute constant. It is not, though, the absolute maximum. The absolute maximum pressure, A_{max}, in the universe occurs in the interior of the nucleon, on the central sphere of diameter d_o given by Equation (3.4). The absolute minimum pressure, A_{min}, in the universe occurs in the vacuum of space, where $A_{min} = A_o$ is given by Equation (2.3). The ratio of the maximum pressure to minimum pressure is given by,

$$A_{max}/A_{min} = h^4/4 \quad (3.7)$$

where h is given by Equation (3.5).

Again, the nucleus of the basic atom is the single nucleon. The force field of the basic atom, as we saw above, is a universal maximum at its nuclear surface and drops therefrom to a universal minimum toward the center (as well as toward the periphery of the isolated atom). In a multi-nucleonic atom, too, the force field remains basically the same. In such a heavy atom, the nucleus will have a grain-like topography seemingly of partially submerged spheres of single nucleons (reminiscent of a rubber balloon filled with marbles instead of air). To the outside field, the nucleus will thus present, at every point on its surface, the sphere of the single nucleon. The force field of the heavy atomic nucleus, too, will thereby be the same universal peak at the surface and tend toward the same universal trough at the center of each surface nucleon (as well as at the atom's outskirts). Well within the heavy and recess-free nucleus (of condensed mass-energy) the force field remains lower than at the surface, with the universal minimum field occurring at the centers of the nucleonic eddies therein. (See Sittampalam 1999, Sections 2.13 and 6.17 for a fuller discussion.)

The ramifications of Equations (3.6) and (3.7) are indeed astronomical, literally. The absolute maximum force and the absolute maximum pressure in the universe, which are associated with the atom, are both finite. That is, *they do not tend to infinity*. Gravitational collapse of matter, therefore, is an absolute nonevent, and the speculated black hole an absolute nonentity, in our physical universe. [The pressure of the vacuum energy field on the atom is naturally transmitted to the core of the atom. Since the pressure on the surface of the atomic nucleus is an absolute constant, the nucleus simply grows in size (nucleon number) should this nuclear surface pressure tend to exceed. (Pressure is an inverse function of radius; therefore, under increasing applied pressure, a given pressure value within the body can only be met at increasing radius.) Thus, under increasing outside radiation pressure, net mass-energy condenses into the nucleus and constancy of pressure on the nuclear surface gets maintained by radial extension of the nucleus—without matter collapse. The maximum pressure, too, that is, at the nucleonic centers, is thereby unaffected. Under any excessive pressure increase, the nucleus simply grows excessively, or buckles and fragments into smaller nuclei when the pressure becomes no longer uniform all around at that higher radius. (The neutron star is thus essentially a gigantic atomic nucleus born, and nestling, under such extreme growth in ambient pressure conditions. Fluctuations in the local pressure field of the nucleus are the basic cause for nuclear decay, the only type of "collapse" there is for matter; a large fluctuation causing a heavy nucleus even to split or bifurcate. (See Sittampalam 1999, Chapter 6; and Sittampalam 2003, Nuclear Reactions.)] The ever increasing "evidence for black holes" has indeed a much simpler explanation in the new light, as we shall see in Section 8.

Further, it is also evident from Equations (3.6) and (3.7) that the absolute minimum force and the absolute minimum pressure in the universe, too, are finite. That is, they do not tend to zero even in the vacuum of deep space where they both occur. Thus, neither the concept of infinity nor the concept of zero from the mathematical domain has any absolute hold in the physical arena. Fundamental physics may now be rid also of absolute zeros and infinities, point particles, and singularities which make even mathematics break down at their thresholds.

Let us consider next the concept of gravity in light of the CMB, which final and quantum insight will pave the way to the unification of physics across its entire realm.

4. The CMB and Quantum Gravity

Many a unification theory for the fundamental forces of nature has been proposed in the past; but gravity, at least, remains extremely difficult to reconcile with the other forces (Weinberg 1993). The root cause for this state of affairs is attributable to none other than our continuing preconception—that gravity is intrinsic to matter. In light of new and improved observations, especially of the past decade, a review of that ancient wisdom seems only long overdue. What is presented here is that review of gravity—but strictly within a framework of well-established laws of classical physics.

4.1. The Most Ubiquitous Force in Nature

An atom (or molecule) is at rest in isolated space. A photon

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strikes the atom. There is a spontaneous exchange of momentum. And the whole atom—including the massive nucleus—moves. Momentum transfer from even a radiowave or a microwave photon thus takes place from atomic level to atomic level—to move also the mighty nucleus.

Photons pack momentum. Though the photon does not penetrate to all levels of the atom, its momentum, nonetheless, does—and goes even to the cores of stars and planets without exception.

Earth's magnetosphere, for instance, extends to several Earth diameters above us (Lyon 2000). The solar wind particles get deflected by this great bubble, which action gives it its comet-like shape with a tail extending to several million kilometers away from the Sun. The magnetosphere thus deflects an enormous amount of momentum every single second. What about all that momentum transferred down to the Earth core as a result? Yes, that's (quantum) anti-gravity (see Sittampalam 1999, Section 1.03, and Sittampalam 2003, Anti-Gravity). Here, however, we shall draw our attention primarily to the equally ill-understood phenomenon that is gravity.

Once again, the atom is at rest in isolated space. This time around, two identical photons strike the atom simultaneously and from diametrically opposite directions. The atom absorbs the energies at a specific level and re-emits the energies from the same level. The two photon momenta being always equal and opposite, the atom gains no net momentum. The atom is unchanged, and continues in its state of rest. The photons, too, are unchanged in energy, having been (elastically) turned around by a non-moving object.

Next, two atoms are at rest in the given space. A distance separates them. Two opposing CMB photons approach the atoms along the line of atomic centers. Each atom, shielded by the other, is struck by only one photon. The photons are re-emitted. Each atom is rendered a momentum. And the two bodies move—or gravitate—toward each other.

And this, basically, is gravity, or quantum gravity since the effect is caused by photons, or energy quanta.

The motion causes the bodies to contract (see Section 5). The compaction or squeeze causes the bodies to eject net energy in the wake and transverse to motion—the "gravitational radiation" in the context here. Each emitted photon is intrinsically lower in energy (that is, apart from the Doppler redshift with respect to the source). This is due simply to the fact that the photon emerges from a level that is itself lower (proportionately squeezed out) in energy compared to the level at zero velocity (see also Sittampalam 2003, Gravity and Relativity).

It may now seem hard to accept the simple fact that shielding of the long-range cosmic radiation pushes bodies together to cause the gravitational effect. [The initial apprehension here is understandable, but the effective overall diameter of the cosmic body for radiation shielding is generally several times that of the opaque sphere that we see. (Earth's magnetosphere—several times Earth's diameter—and the effect it has on the solar wind highlight this universal fact.) Moreover, the long-range radiation includes the sea of neutrinos now known to pervade space, which copious energy particles are also lately detected to have a gravitational effect (Dickson and Schutz 1995). In other words, the absolute pressure of the vacuum on material bodies is very much in underestimation today. When redressed, as done here, the long-sought and simple theory of quantum gravity becomes also an unquestionable reality. Physics should thus see a radical reawakening across the board when our old notion of gravity—that this most ubiquitous force in nature springs from within matter with some mystical pulling or space-warping power—gets corrected. We can now totally do away with our search for the constructs of the old theory such as black holes, dark matter, and big-bang relics. (Complacency could only see research cost skyrocket further without an end in sight.)] Our current concept of the phenomenon, on the other hand, seems virtually unquestioned; a concept that some exotic energy, constantly emanating from the bodies themselves with some mystical tendrils to grab and pull (or even warp and bend space and time) produces the effect. We have been weaned on the latter from early years and, therefore, easy to accept without question. But science stands still without inquiry.

However, the utter simplicity of the final concept, once known to the larger science community, should make it even harder to ignore for the true advancement of science.

4.2. The Breathing of Celestial Bodies

A body, X, in isolated space absorbs the long-range radiation and emits the energy out. It is a spontaneous exchange of the body with the cosmic quantum field. And the frequency of exchange corresponds to the body's natural breathing or vibrational cycle in that environment.

A body, Y, of greater mass (more nucleons) would thus exchange a larger amount of energy with the outside field. The flux of the outside field being the same, however, it would take a longer time for the greater mass of Y to inhale and exhale. That is, the larger the body, the larger is its period of natural vibration.

Thus, for instance, the hydrogen atom (1 nucleon) would have a certain vibrational period in isolated space, and the helium atom (4 nucleons) a larger period. (This period of He, though, is not necessarily four times that of H, since other factors, such as exact mass and shape of nucleons, determine the breathing amount.)

The above insight is simply to highlight the fact that the cosmic field energy intercepted and re-emitted by, say, a celestial body is a function of its mass; and that this mass function cannot be taken to be a linear one.

4.3. Derivation of the Inverse-Square Law of Gravity

The CMB is isotropic and homogeneous in isolated space. [Strictly, the term CMB here refers to the entire spectrum of isotropic radiation from space. Half of this energy consists of the presently ill-understood neutrinos. In the new light, the photon and the neutrino do not have much fundamental difference. Both move at speed c and both pack energy and momentum. The only difference is in their mode of propagation: The photon is essentially one-dimensional, proceeding in a straight line from its source; and the neutrino is two-dimensional, expanding radially from source (see Section 6).] Its energy E_0 and momentum P_0 per unit area per unit time will thus be a constant (see Section 2.1). Consequently, the pressure that this radiation exerts on a totally reflecting (hypothetical) surface, too, will be a constant.

Again, as we saw in Subsection 2.1, pressure is momentum

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change per unit area per unit time. Hence, the CMB pressure, A_o, on a totally reflecting surface will be $2P_o$, since, reckoned vectorially, the change of momentum per unit area per unit time is P_o on impact plus another P_o on recoil (reflection); or,

$$A_o = 2\,P_o \tag{4.1}$$

where,

$$P_o = E_o/c \tag{4.2}$$

In general, the amount of energy absorbed and emitted by a real body depends on its mass and other properties. In other words, it would be incorrect for us to assume that this energy exchange is a function of the body mass alone. Therefore, let us simply say that, at steady state, a given body of matter in isolation exchanges energy with the CMB field that is k times its mass m, or km, per unit time. (The factor k can be considered a constant *only* for bodies identical to this specific body, that is, of a given mass, chemical composition, form, shape, and even ambient conditions.)

Thus, the body at isolated rest would in effect exchange, radially from its mass center, an energy of km with the isotropic CMB field. [We are deriving here an expression for the force of gravity; an expression that has only been an empirical fact until now. The particular approach of analysis chosen here is simply to bring the derived expression in a readily recognizable classical form, which is Equation (4.8), a well known equation perhaps even in grade school.]

Now, purely for our analysis here, let us replace this real body with a hypothetical sphere, S, that is totally reflecting to the CMB radiation. The surface area of S will be $4\pi r^2$, where r is the radius of the sphere. Further, let the energy (and momentum) exchange between S and the CMB field be the same as that between the real body and the CMB. Thus, the physical effect between body and CMB field will be the same in the two cases. (Physical effect here is simply momentum transfer, which is the same whether a body absorbs and re-emits a photon or simply reflects it off at the surface.)

Since the real body absorbs and emits energy km per unit time, and body S would reflect the same amount at its surface (where the energy would come in at E_o per unit area per unit time), it follows that:

$$4\pi r^2\,E_o = km \tag{4.3}$$

Now, a body of mass m_1 would exchange energy k_1m_1 and a second body of mass m_2 would exchange energy k_2m_2 when each body is in (the same) isolated space on its own. (Again, it would be wrong for us to assume that $k_1 = k_2$.)

Hence, for their corresponding analytical bodies, S1 and S2 of respective radii r_1 and r_2, it follows from Equation (4.3) that:

$$4\pi r_1^2\,E_o = k_1m_1 \tag{4.4}$$

and

$$4\pi r_2^2\,E_o = k_2m_2 \tag{4.5}$$

Let S1 and S2 be now placed with their centers separated by a distance of d, as shown in Figure 1. The two spheres would thus shield each other from a part of the CMB onslaught, causing between them a CMB void. The resulting force imbalance across hemispheres causes thereby each body to be pushed toward, or be seemingly attracted to, the other. And this, basically, is the gravitational effect between celestial bodies.

Figure 1 shows the two analytical—or gravitational—spheres S1 and S2, but detailing only the CMB shielding of S1 by S2. Considering S1, the left hemisphere faces the full CMB impact. However, on the right hemisphere, the impact force on segment O_1XY of the sphere gets blocked by S2. And this force, say, F, or the lack of it, causes S1 to be sucked or pushed toward S2.

Now, from fluid mechanics, the force, F, on the spherical surface area XY under pressure, A_o, is the same as the force on the flat, circular (cut-away) area, of radius b, at XY under the same pressure, A_o. (Area of the latter surface is therefore πb^2.) That is,

$$F = \pi b^2 A_o \tag{4.6}$$

From Figure 1, it is also now easily shown that:

$$b/r_1 = \sin\theta = r_2/d \tag{4.7}$$

Whence, from the above

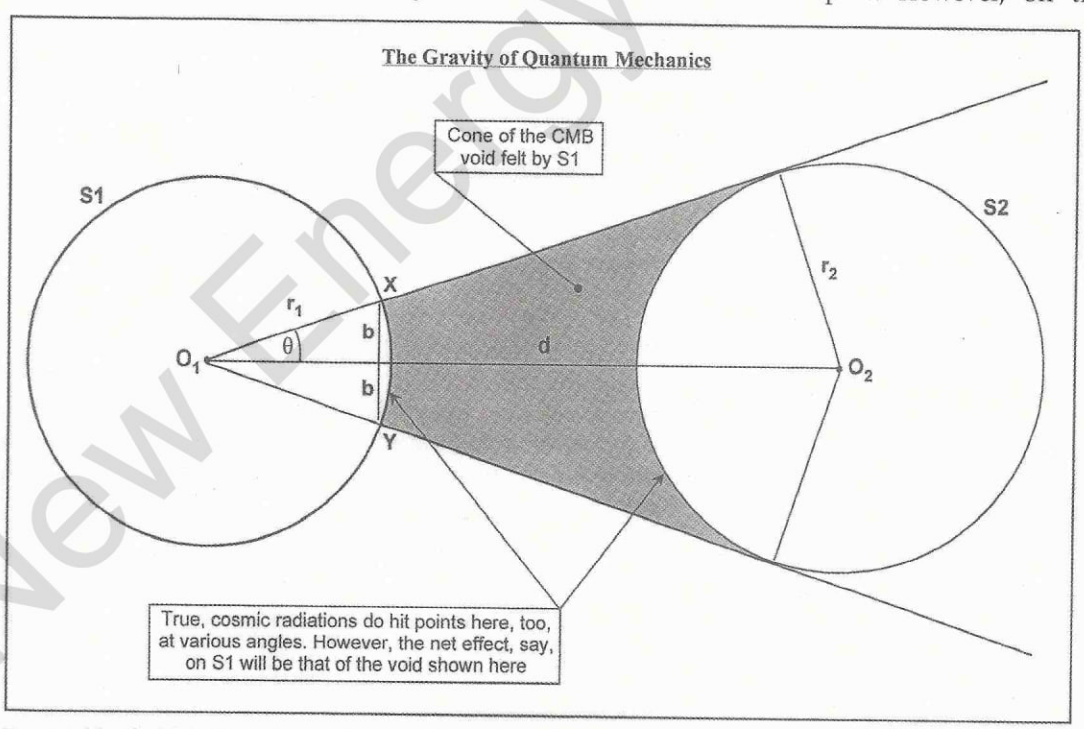

Figure 1. The CMB shielding of S1 by S2. Only the analytically equivalent gravitational spheres, S1 and S2, of the two celestial bodies are shown here.

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seven equations, we get,

$$F = Gm_1m_2/d^2 \quad (4.8)$$

where

$$G = k_1k_2/8\pi E_oc \quad (4.9)$$

Equations (4.8) and (4.9) show F to be mutual between the two bodies. That is, if suffixes 1 and 2 are interchanged in the equations, force F would still remain the same, showing the CMB shielding of S2 by S1 to be the same in magnitude.

The CMB energy per unit area per unit time, E_o, and its velocity, c, may be justifiably taken as universal constants, but not the factors k_1 and k_2. Thus, G can be considered the gravitational constant only for the particular pair of bodies considered. This is the fundamental reason why experiments to measure G will keep on showing varied results (Schwarzschild 2002), let alone a universal constancy, even for the same quantity of matter (mass) but of different form, shape, chemical composition, or even ambient conditions. It is thus now easily predicted: The more varied and refined the experiments, the more diverse will be the value of G.

We arrive next at, perhaps, the most important crossroads of all in science—where we shall see, in the new light, that long-sought union taking place between quantum mechanics and relativity.

5. The Vacuum Energy Field and the Contraction of Moving Bodies

The following are the opening sentences in *Encyclopedia Britannica 2000* on the Lorentz-Fitzgerald (L-F) contraction: "Lorentz-Fitzgerald contraction, also called *space contraction*, in relativity physics, the shortening of an object along the direction of its motion relative to an observer. Dimensions in other directions are not contracted."

The L-F contraction factor, as we may all know, is $(1 - v^2/c^2)^{1/2}$, where v is the velocity of the object. The factor is purely ad hoc and has never been derived from first principles. Moreover, the non-contraction along directions transverse to motion is another such article of faith (see, for instance, Born 1965).

We shall quickly investigate here—for the very first time in the history of science—the physical basis for this contraction. It will also shed for us that extra light to see the utterly simple mechanism which underlies the mystery that is the speed of light in moving frames.

First, to help relieve ourselves of any apprehensions, the crucial difference that makes it all classical mechanics now for relativity theory is summarized in a few astoundingly plain and simple lines. For convenience here, let us denote $(1- v^2/c^2)^{1/2}$, the L-F contraction factor, by δ. Thus, the gist of the speculated L-F contraction—central to Einstein's relativity—and that of the contraction that in reality takes place in nature are as follows. Consider the isolated atom (or molecule).

1. The L-F Concept

In inertial space:

(a) The atom at rest has zero contraction: Longitudinal dimension/Transverse dimension = 1/1 = 1.
(b) Under motion at velocity v, the body has zero contraction in the direction transverse to motion: Transverse dimension = 1.
(c) Under motion at velocity v, the body contracts by the factor δ in the direction of motion: Longitudinal dimension = δ.
(d) The contraction of body in the direction of motion with respect to its transverse dimension is thus δ/1, or δ.

2. The Final Concept

In absolute space, the space of the CMB:

(a) The atom at rest has zero contraction: Longitudinal dimension/Transverse dimension = 1/1 = 1.
(b) Under motion at velocity v, the body contracts by factor δ in the direction transverse to motion: Transverse dimension = δ.
(c) Under motion at velocity v, the body contracts by factor δ^2 in the direction of motion: Longitudinal dimension = δ^2.
(d) The contraction of body in the direction of motion with respect to its transverse dimension is thus δ^2/δ, or δ, as in (1d) above.

Hence, the L-F Contraction Factor, though empirically correct, by virtue of 1(a), 1(d), 2(a), and 2(d)—the reason for the seeming success of Einstein's relativity theories in certain observations—the concept is still *fundamentally flawed*, by virtue of 1(b), 1(c), 2(b), and 2(c)—the reason for the limitations of Einstein's relativity theories.

5.1. The Velocity of Light

Perhaps man's most important empirical discovery of all time is the fact that light travels at a speed or velocity that is finite—not infinite as he had thought earlier. Moreover, he finds the velocity of light to be amazingly constant even in vacuo—as if the energy was being transmitted, like sound, through a physical medium. And he reasons: maybe the void we see in separating matter is not as empty as we thought it was; perhaps some medium does pervade the seeming emptiness after all.

His gut feeling was not off the mark. To the contrary—it was dead on target!

As we are now learning, the entire universe of our observation—classical matter and vacuum alike—is indeed a recess-free physical medium. It is an indefatigably vibrant continuum of mass-energy where radiatons conveniently serve us as the ultimate and unique analytical constituents. And, detectably, the radiaton appears at speed c as the per-cycle energy quantum of the photon.

And, perhaps, man's least understood of all physical phenomena is the seeming constancy of that speed of light irrespective of how the source or the observer is moving. It still looks just as ridiculous to us today as it first did to Einstein, Poincaré, Lorentz, Fitzgerald, Michelson, Morley, and a host of other leading scientists of a century ago. How can the speed of light possibly measure the same finite value whether you approach the beam or move away from it? A straightforward and rational answer has remained beyond our grasp even to the present day (Hawking 1988).

But, with the final insight now into the submicroscopic world of mass-energy, we have that simple explanation to the seeming invariance of c in moving (inertial) frames.

5.2. Derivation of the L-F Contraction Factor

The space and time of the CMB radiation serve us respectively as absolute space and absolute time. The reference (or "rest") frame of the CMB thus becomes to us the absolute and preferred inertial frame of reference. And it is in this unique frame alone that light has the absolute velocity of c.

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To explain basic principles, consider the basic atom. In isolation and at rest in absolute space, the space of the CMB, the body will thus be in a vacuum energy field that is isotropic. There will be no net transfer of the CMB photons, or radiatons, to or from the atom over its vibrational cycle. And the body would continue its (steady) state of rest with zero net force across hemispheres. That is, the rate of radiaton exchange across a hemisphere would remain equally matched by the rate of such exchange across the opposite hemisphere. This cycle of energy absorption and emission, of course, occurs at the natural frequency of vibration of the atom. The frequency of this cycle, therefore, will measure the same in all directions in the rest frame of the body.

Thus, radiatons would impinge the atom at a level corresponding to diameter λ_o [as per Equation (3.1), above] and get ejected therefrom at spatial intervals of λ_o, or time intervals of λ_o/c, in every radial direction, where λ_o is the wavelength of the CMB. That is, the radiatons would get absorbed in over a half cycle and get emitted out over the next half cycle, and the cycle would repeat. This, in effect, may be considered as the body simply reflecting off the radiatons over each cycle at that level. That is, the radiatons would approach the body over a half cycle and get reflected back over the next half cycle (Figure 2), and the cycle would repeat. (Note: Momentum exchanged between radiaton and atom is 2mc whether the atom absorbs and emits the radiaton or simply reflects it.)

Consider next the body in uniform motion at velocity v in absolute space (Figure 3). The effect of the CMB is no longer isotropic for the body. It becomes polar. In front of the body, the radiatons approach at (c + v) relative to the body and leave at (c – v). At the rear, the situation is reversed: the radiatons approach at (c – v) and leave at (c + v). At uniform velocity, as at rest, there will be no momentum change for the body. (Alternatively, a simple analysis will show the momentum transferred to body by the radiatons fore and aft to cancel out here, too, each cycle.) Hence, the wavelength, say, λ_v, of the particle bombardment will be the same fore and aft in the frame of the body.

Thus, relative to the body, the radiaton will have a vibrational displacement of $\lambda_v/2$ in front as well as in the rear where the radiaton speed will be (c + v) in one direction and (c – v) in the opposite direction (Figure 3).

Therefore, in the frame of the moving body, the period, t, of the cycle, which is displacement divided by velocity over the two half-periods, will be,

$$t = [(\lambda_v/2) / (c + v)] + [(\lambda_v/2) / (c - v)]$$

or,

$$t = \lambda_v c / (c^2 - v^2) \qquad (5.1)$$

Transverse to motion, a simple vector diagram (Figure 3, once again) will show the particle to approach and depart at the *same* speed of $(c^2 - v^2)^{1/2}$ relative to the body.

Thus, the period t (common for the selfsame breathing body), which here is simply wavelength divided by velocity, will be,

$$t = \lambda_{vt} / (c^2 - v^2)^{1/2} \qquad (5.2)$$

where λ_{vt} is the wavelength of transverse particle bombardment in the frame of the body.

From Equations (5.1) and (5.2), we then get,

$$\lambda_v / \lambda_{vt} = (1 - v^2/c^2)^{1/2} \qquad (5.3)$$

The right hand side of Equation (5.3) is clearly less than unity for nonzero v. Thus, since λ_v and λ_{vt} also directly correspond to atomic radial levels, as per Equation (3.1), the atom's effective dimension λ_v along the polar axis has become less than its equatorial dimension λ_{vt} by virtue of motion.

In other words, the atom's "thickness" λ_o at rest has, by virtue of motion at v, contracted to λ_v along the line of motion and to λ_{vt} along the transverse direction. [Equation (5.3) tells us that λ_v is always less than λ_{vt} for nonzero v. However, when v = 0, $\lambda_v = \lambda_{vt} = \lambda_o$; and when v tends to c, λ_v, being equal to $\lambda_{vt}(1 - v^2/c^2)^{1/2}$, would tend to zero. These show the body under motion to be always contracted transverse to motion and to be even further contracted along the line of motion.] And Equation (5.3) gives the relative contraction, that is, the contracted absolute dimension in the direction of motion in reference to the also contracted absolute transverse dimension.

Equation (5.3) is directly identifiable with the famous L-F contraction hypothesis. And, for the very first time in physics, the expression is derived here from first principles. It may also be noted that:

a) The L-F hypothesis, though empirically sound, is still fundamentally flawed for want of a theoretical basis. That is,

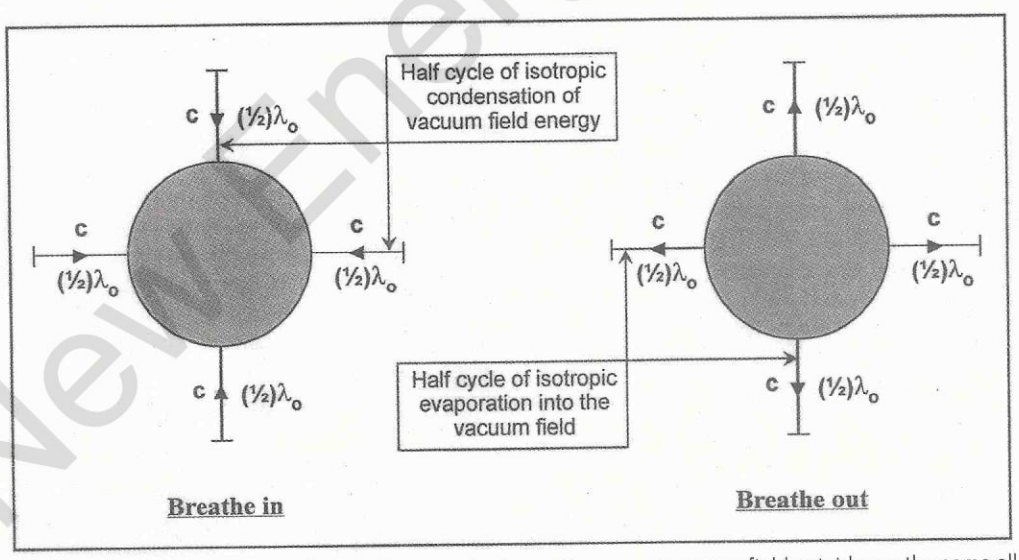

Figure 2. Body at rest. The exchanges between body and the vacuum energy field outside are the same all around. Velocity c and wavelength λ_o are with respect to absolute space, the space of the CMB, in which the body is at rest.

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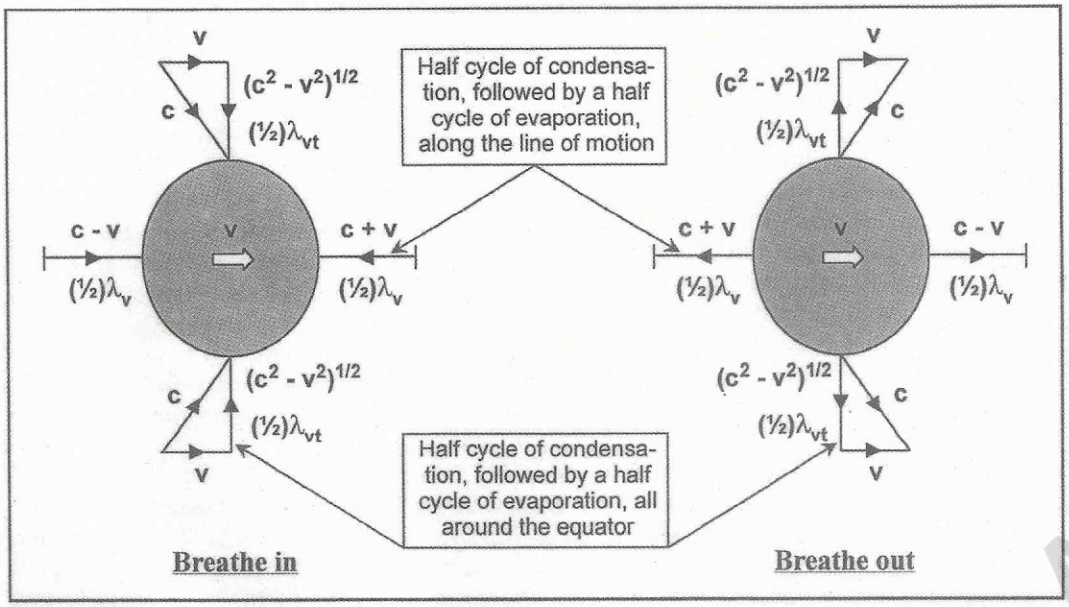

Figure 3. Body at velocity v. The exchanges become polar. Individual velocities c and v are with respect to absolute space; wavelengths and combined velocities are relative to body moving at v.

neither Lorentz nor Fitzgerald was aware that the transverse dimensions, too, contract absolutely; and that it is based on this diminished transverse dimension does the longitudinal dimension further contract by the factor of $(1 - v^2/c^2)^{1/2}$.

b) Every atomic level exchanges energy with the outside vacuum field (which breathing sustains the atom; see Section 3, above). Hence, the contraction under motion takes place at every atomic level and layer of the body, that is, by the same L-F factor.

c) An imbalance in the longitudinal effect of this long-range vacuum field on (every atomic level and layer of) the body is what gets manifested as an effect due to the body's so-called inertia: The forward effect of the vacuum field on the moving body is the inertial drive; the counter effect is the inertial resistance; acceleration of body causes a net inertial resistance; deceleration causes a net inertial drive; and uniform motion sees a counterpoise between inertial drive and inertial resistance, as at rest; any reference frame in which the body experiences no net effect from the vacuum field is thus termed an inertial frame of reference (Sittampalam 1999, Sections 4.02 and 7.01).

d) An imbalance in the transverse effect is that which causes the centrifugal effect on the body (Sittampalam 1999, Section 7.05).

e) Without exception, it is momentum and momentum alone of the radiaton that is fundamentally transferred in any and all interactions in nature, be it gravitational, electromagnetic, or nuclear (Sittampalam 1999, Chapter 2).

Hence, a contraction of body occurs not only along the direction of motion but also (to a lesser extent) transverse to motion. In the moving frame of the body, however, this absolute dipole asymmetry will not be verifiable by any physical means, as we shall see next.

5.3. The Velocity of Light in Moving Frames

The velocity c is absolute. It is in reference to an absolute inertial frame, the frame of the CMB. Therefore, in reference to any other frame moving relative to this unique and preferred frame, the velocity of light will generally be something other than c in magnitude. It also follows that even within a moving *inertial* frame the velocity of light will not be the same in magnitude in all directions. In other words, the velocity of light propagation will *not* be isotropic in *any* frame that is moving in absolute space, the space of the CMB.

But for physical verification, man is left with only physical means—his rods and clocks. These measurement instruments of man all consist basically of atoms. And it is at this basic level of the atom that the distortions all start.

In the frame of the atom moving at velocity v, let the effective velocity of light along the polar axis be c_v; and that along a radius through the equator be c_{vt}.

Velocity is wavelength divided by time period. Hence, from Equations (5.1) and (5.2) we will get, respectively,

$$c_v = \lambda_v/t = c(1 - v^2/c^2) \qquad (5.4)$$

and,

$$c_{vt} = \lambda_{vt}/t = c(1 - v^2/c^2)^{1/2} \qquad (5.5)$$

Dividing Equation (5.4) by Equation (5.5), we then get,

$$c_v / c_{vt} = (1 - v^2/c^2)^{1/2} \qquad (5.6)$$

Clearly, from Equations (5.3) and (5.6), it is not only the atom's wavelengths of energy transfer along and transverse to motion that are affected by the L-F factor but also the velocities of the transferring energy along those directions—by the very same factor.

We have so far considered only the polar and equatorial points of the atom. The radiaton exchange normal to the surface at any other point, too, will have an effective wavelength and velocity. However, their magnitudes will only be intermediate to their polar and equatorial counterparts, but with the all-important (and scalar) time period, t, remaining common for all points from pole to equator. That is to say, the wavelength of transfer divided by the velocity of transfer will be equal to the constant period of transfer, t, with both wavelength and velocity tending from a minimum at the poles to a maximum at the equator.

Hence, we may summarize that in any inertial frame where the light source and detector are at rest:

(A) By virtue of Equations (5.3) and (3.1), the wavelength of light and the material instrument that measures it are both subject to the same factor of change. In other words, the wave-

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length of light will physically measure the same in *any* direction from the source and irrespective of the frame velocity.

(B) Energy from an atomic level is its energy of vibrant emission from that level. As such, in the source frame, the energy will register the same constant frequency in any direction of propagation. But, from (A), the wavelength, too, is observed as a constant for the energy in any direction in the source frame. Thus, as a result, we have been wrongly concluding to date that (essentially) frequency of light times wavelength of light, which product is the speed of light, is absolute and isotropic in all inertial frames, that is, in contravention of Equations (5.3) and (5.6).

Again, from *Encyclopedia Britannica 2000*: ". . .time dilation, also called *time dilatation*, in the theory of special relativity, the 'slowing down' of a clock as determined by an observer who is in relative motion with respect to that clock."

There is no more need for recourse, therefore, to space contraction or time dilation (to hold c absolute in moving inertial frames). Space and time are absolute in the radiation field of the CMB. And it is in this unique space of the CMB alone does c remain an absolute constant. (The phenomena attributed to time dilation, too, naturally, have much simpler explanations in the real quantum world; see Sittampalam 1999, Sections 1.21, 4.10, and 4.11; and Sittampalam 2003, Relativity.)

5.4. The Final Theory of Relativity

In the absolute reality, it is light's travel time that remains the only invariant for a given distance in an inertial system. That is, if two points A and B are at rest in an inertial frame, then light's travel time between the fixed points A and B will remain the same absolutely irrespective of the frame velocity v or the orientation of the line AB with respect to v. Under any given change in v, in magnitude and/or direction, it is the distance AB and the velocity of light between A and B that change absolutely, and they both change by the very same factor. And since velocity equals distance divided by travel time, the factors of change cancel out in the equation to give us the illusion of the invariance of the velocity of light in moving inertial frames. This, as we saw above, is the direct consequence of bodies contracting not only in the direction of motion but also transverse to motion (by factors related to the L-F hypothesis). And this reality of matter has made all the difference in bringing relativity down to earth from its abstract perch. Hence, however sophisticated the instrument and advanced the technique, any experiment in an inertial frame may now be deemed to be in error should it find a difference in light's travel time between two fixed points at different orientations of their connecting line with respect to the frame velocity. [Basically, these were the empirical facts that were most conclusively verified for us in the famous Michelson-Morley experiment of 1887—which led to Einstein's Special Relativity. The final interpretation of the experiment, though, is now a very simple one (if not superfluous). It is given in Sittampalam 1999, Chapter 10. It is also important to note that these results need not be any different at all in noninertial frames where actual experiments are performed, as was the Michelson-Morley experiment. (A reference frame is a noninertial one when its velocity is not fixed in magnitude or direction in absolute space, the space of the CMB.) This would only and simply mean that the effect of the change in the frame velocity (v)—in the fleeting time the photon takes to traverse the experimental distance (AB)—is beyond detection.]

The following illustration should help us further understand these profound, yet simple, facts of the submicroscopic world brought to light here.

Imagine yourself on a platform at rest in absolute space, the space of the CMB. There are two identical light sources and a single light detector fixed to the platform. One light source is at a distance in front of the detector and the other at a distance to the side. The wavelength and frequency of the energy you measure from one source are the same as the ones you pivot the detector and measure from the other source. (This also confirms that the two sources are identical in energy emission.)

Next, consider the platform moving you forward at uniform velocity v along with the light sources and detector. You carry out the same measurements as before. The wavelength from each source has contracted by a certain factor and the atoms of the detector, too, have contracted by the same factor in that direction. (For that matter, you, the platform, and everything else moving with you have contracted by the very same factor in that direction!) Hence, you do not detect any wavelength change from your earlier measurements, when the system was at rest. Further, the source and detector atomic levels of energy transfer being always of a common frequency, there is also no frequency change registered by the detector in the various situations. You repeat the experiment (though superfluous) at a different magnitude and direction of v. Again, the results show no variance whatsoever from earlier ones. That is, to material instruments, the wavelength, and frequency of energy transfer between emitter and receiver remain the same in all situations.

And you conclude: Velocity is frequency times wavelength ($c = f\lambda$). Since there is no change detected in either frequency or wavelength from any of the (identical) sources, the velocity of light is an absolute constant in all inertial frames and in all directions of propagation irrespective of frame velocity.

Are we correct anymore in drawing these conclusions, that is, to say: $c_v = c_{vt} = c$? And whither now Special Relativity?

The similar insight into the phenomenon of (quantum) gravity in Section 4 would also now beg the question: And whither now General Relativity?

6. Neutrinos and Gravitational Radiation

In cosmological discussions, both neutrinos and antineutrinos are referred to simply as neutrinos for brevity's sake. We shall adopt the practice here, making the distinction only when necessary. (See also Sittampalam 1999, Section 6.06; and Sittampalam 2003, The Neutrino.)

6.1. Origin of the Neutrino

The proton and the electron are the most basic sub-c particles of matter that are stable in nature. Their stability in the mass-energy continuum lies in their intrinsic handedness—a nonvanishing seminal linear momentum coupled with a nonvanishing seminal angular momentum, or spin. (See Sittampalam 1999, Section 2.06; and Sittampalam 2003, The Spin.)

The basic sub-c particle of matter breathes. Over exhalation, a mass-energy quantum ejects from the north pole. The south is suddenly thrust against a resistive vacuum energy

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field (the resistance of inertia; Sittampalam 1999, Section 4.02). The combined action at the poles tends to cause the body to bulge at the equator. And a quantum around the spinning equator fully attains speed c and escapes the body, maintaining thereby the critical diameter λ_n at the equator.

The polar and equatorial quanta thus exhaled are complementary and comparable; one does not occur without the other; in the great and vibrant mass-energy continuum, there is no action without reaction—even in directions transverse. The polar transfer is intense since it is one-dimensional (along the polar or spin axis). The equatorial transfer, though, becomes less intense with distance from the spin axis since it is two-dimensional and radially divergent. The polar and equatorial quanta of inhalation are very similar to their respective exhalation counterparts, only reversed in effect on the spin particle.

All four transfer quanta—polar and equatorial influx and efflux—are counter to the seminal motions of the particle: The polar influx (at the leading south) and efflux (at the trailing north) are both opposite to the particle's seminal linear motion; and the equatorial influx and efflux (along the equatorial plane and tangential to the particle surface) are both opposite to the particle's seminal spin. Over a breathing cycle at steady state, for instance, there is null effect on the particle from the four transfer quanta—a change neither in mass-energy nor in momentum for the particle. [The spin change over a half cycle is of a constant magnitude $\hbar$, given by $\hbar = h/2\pi$ (where h is Planck's constant), that is, irrespective of the quantum of mass-energy transferred. Thus, over exhalation, nucleons and electrons each gain a unit spin quantum of $\hbar$; over inhalation, the spin gain is lost. The cycle thus gives the particles a statistical $\hbar/2$—their characteristic "half-spin"—that is measurable. (See Sittampalam 1999, Section 5.04, for the derivation of formula, $\hbar = h/2\pi$, for the first time ever from first principles.)]

The transfers always take place at speed c over the natural vibrational cycle of the spin particle. Due to their intensity, the polar quanta are detectable; we now recognize them as magnetic radiation (Sittampalam 1999, Section 5.01). The less intense equatorial transfers, though, are unrecognized as such today—but they underlie the electrical effect (Sittampalam 1999, Section 5.08).

On the other hand, however, should the polar transfer quantum be unusually large, like the electron emitted in the neutron's final breath, that is, in the neutron decay, the corresponding equatorial quantum heaved, too, becomes unusually large—and detectable. And that's what we detect, though still with some difficulty, as the neutrino. Although the polar quantum here is a sub-c particle (electron), the comparable equatorial quantum (neutrino), being two-dimensional and radiating, or thinning, out, breaks out only as speed-c mass-energy. (See Sittampalam 1999, Sections 6.01 to 6.03, for the full mechanics of neutron decay.)

Thus, the neutrino propagates (only) at speed c. (The handedness, or helicity, of this quantum of nuclear recoil is readily reckoned; see Sittampalam 1999, Sections 6.06 and 6.08.)

6.2. Detection of the Neutrino

There is a misconception today that the neutrino can pass through, say, the Earth without even affecting a single atom (Bahcall 1989). In the renewed light, however, as we have just seen, the quantum that is the neutrino recoils from around the equator of the subatomic particle of origin. It is thus nuclear in origin and, therefore, will be nuclear in effect, like the gamma ray. But, unlike the gamma ray, the neutrino has a two-dimensional and radial spread, which causes the energy packet of radiatons (its analytical constituents; subsection 2.3, above) to drop in intensity with distance. On the other hand, however, this wider field of influence enables the radiatons to intercept much more atoms than would the radiatons of the essentially one-dimensional photon. Since the neutrino possesses energy, it also packs momentum—and transfers it successively, in a radial domino effect, to *every single atomic nucleus and electron* along its way, subtle and beyond detection though the effect may be on individual atoms, especially with distance.

Nevertheless, in an intense stream of neutrinos, as from a supernova explosion, Earth detectors are now able to register an effect (Bionta 1987; Hirata 1987). As nuclei and electrons of the detection medium recoil from the neutrino impact and successively pass on the effect, certain electrons down the line get a concentrated, or lensed, effect strong enough to knock them off their atoms and thereby cause detection. In other words, the interference of the neutrino wavefronts can, at times, cause a detectable effect even though generally every atom of the medium gets thumped without a seeming whimper.

This model of the neutrino would now explain its seeming elusive nature with which it has been synonymous.

6.3. Neutrinos and the CMB

Again, in principle, the neutrino is no different to the equatorial emission that occurs over the *normal* vibrational cycle of the spin particle. That is, the most intense emissions are the ones we now recognize as neutrinos, which emerge from relatively infrequent nuclear processes. (Two such processes are the neutron decay, which produces the electron antineutrino; and the proton-proton fusion, which produces the electron neutrino.) Thus, the classical vacuum is simply a sea of photons and neutrinos of the breathing matter, excited and otherwise. In other words, the long-range radiation field of the cosmos is constituted as much by neutrinos as it is by photons. This implies that neutrinos, too, transfer the gravitational effect, which is indeed a fact of observation today (see, for instance, Dickson and Schutz 1995). Therefore, as also discussed in Section 2, above, even the minimal cosmic background radiation flux of E_o would include the prolific contribution also of the neutrino.

7. The Cosmological Redshift

The cosmological redshift is a systematic shift observed in the electromagnetic spectra of *all* the far galaxies without exception. It is found that the wavelength shift toward the red increases with the distance of the galaxies from the Earth (see, for instance, Peebles 1993).

7.1. The Cosmic Photon and the Age Paradox of the Universe

In physics today, it is taken for granted that the energy of the photon emitted is the energy of the photon detected. When the source and receiver are at relative rest, the photon wavelength is measured to be unaffected; when the two relatively approach each other, the wavelength shortens, or blueshifts; and when the two recede from each other, the wavelength extends, or redshifts. These are amply borne out in the laboratory. With the near galaxies, too, they seem to

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hold out well with other observations. Therefore, it was assumed that the wavelength shifts are purely the Doppler shifts due to relative motion and that the intrinsic energy of the photon *is not affected at all* while in transit. And the concept got extended to the far reaches of the cosmos.

The exercise remained unchallenged. The indifference was not something unexpected. With the photon itself not well understood to start with, there wasn't much ground for contest anyway. And so, from astronomical observations, Edwin Hubble in 1929 made the "fundamental discovery" that the universe is expanding—the galaxies are all moving away from each other at a rate proportional to the distance between them. Shifts, or displacements, of spectral lines toward the red end of the spectrum are observed in all spectrograms taken with light from distant galaxies (Peebles 1993; Rees 1997).

But, lately, this picture of cosmic grandeur has become very controversial. The universe is younger than some of the stars it contains, it also seems to imply when viewed in the light of other observations (Bolte and Hogan 1995). Then, again, with the photon ill-understood in the first place, such a paradox, too, should not be something unexpected.

Observations do not lie; neither are they partial to popular or fashionable theories of the day. They reveal, instead, the sublime truths of nature. It is our interpretations of the data that have been in dire want. *The Hubble expansion of space is a misconception.* It is a gross miscarriage of interpretative science that has unnecessarily taken physics into a fantasy world of singularities with so-called Big Bangs and Big Crunches. However, in light of the ultimate concept now of the photon, the misgivings of the cosmological redshift find a simple and final resolution.

7.2. The Non-Breathing Photon

Consider, first, the single photon. Let its energy be E, frequency f, and wavelength λ. The length of the photon will be λ_o (Section 2). Within this length, the photon will be constituted (analytically) by a string of radiatons of speed c and, say, n in number. The energy of each radiaton will be e.

Thus, it readily follows,

$$c = f\lambda \tag{7.1}$$

$$E = hf \tag{7.2}$$

and,

$$E = ne \tag{7.3}$$

Whence from Equations (7.1), (7.2), and (7.3) we get,

$$\lambda = hc/ne \tag{7.4}$$

Now, electromagnetic radiation through free space is simply a stream of energy moving at speed c. Analytically, it is a stream of radiatons effecting a vibrational energy transfer through the vacuum field radiatons at speed c. The particles of the stream are not necessarily arranged into lines of definite wavelengths; neither do individual particles maintain specific wavelengths at all time; in other words, electromagnetic radiation is more of a particle soup in flow. Should an instrument that measures, say, wavelength intercept the flux, what really gets detected is simply the *statistical* wavelength(s) at which the particle flow peaks in intensity. That is, at any such wavelength, the effect transferred to the material instrument becomes at least detectably sufficient. And at such a wavelength, λ, the corresponding photon will be made up of n number of radiatons satisfying Equation (7.4).

In the laboratory, the photon makes a straight line from the source to the detector. It hardly suffers a lateral deviation due to any asymmetry of the ambient field. (We minimize material objects very close to the line of propagation to avoid diversion or redistribution of the energy intensity in space, which we call diffraction.) In the local region of the cosmos, too, any effect caused by variation from a straight-line path is not measurably significant. (Here, too, we avoid those lines of propagation that, for instance, graze the Sun or the stars). But photons from the far galaxies get considerably subjected to asymmetries in the exceedingly long intervening space of the intergalactic. We cannot avoid them because every single line of radiation reaching us gets affected appreciably by asymmetric fields en route. (A galaxy, for instance, would shield the CMB radiation on one side of the passing energy stream causing the stream to swerve toward the galaxy. On the long haul, the effects of these diversions add up and cannot be ignored.) And farther the source, more are the lateral shiftings and meanderings of the energy streams reaching us.

The radiatons of the stream pack momentum and they move always at speed c. Through long intergalactic space, however, they are pushed from post to pillar by the asymmetry of the regional fields along the way, that is, even in the generally non-material medium of intergalactic space. Thus, *the stream of momentum particles moving at constant speed c is forced to change its state of straight-line motion.* This entails transverse acceleration—and transverse momentum change. And every such momentum change by a lateral "squeeze" in one direction causes the stream to counter that effect by ejecting part of its radiatons laterally in the opposite direction—and out of the mainstream.

A simple illustration here should now help us understand these actions more clearly. An earthbound stream of photons from a distant supernova passes over a galaxy cluster. The photons feel the long-range field to be lopsided due to the galaxies shielding the CMB from below. This is, of course, due simply to the radiatons of the stream getting pelted by the CMB radiatons more from the top than from the bottom. The differential pelting causes the stream to veer down. And, what do you know, on the flip side, the shielding of the CMB by the photon stream similarly causes the galaxy cluster to get drawn up! Absurd though the latter may seem, it is, in principle, true and needs consideration in the context here. (This is akin to the airfoil effect, which lifts jumbo jets against gravity; see Sittampalam 1999, Section 7.06.) Now, the momentum of the system—galaxy cluster, energy stream, and the regional field—is strictly conserved. Thus, in net effect, the momentum of the cosmic field surrounding the "bubble" containing the system is unaffected. Within this imaginary cosmic bubble: 1) The energy stream veers down by scattering part of its radiatons to the top. 2) The galaxy cluster draws up by scattering part of its radiatons to the bottom. 3) The movement of the cluster is also slightly in the forward direction of the energy stream since the latter's shielding (gravitational) effect is continuously moving in that direction. 4) The momentum of the original photon stream gets conserved in the surviving stream together with the (additional) forward momentum of the galaxy cluster. 5) The transverse momentum of the original stream being zero, it remains con-

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served at zero by the opposing movement of the surviving stream and galaxy cluster together with the radiatons they scattered. (Figures for this illustration are given in Sittampalam 2003, The Cosmological Redshift.)

This is the reality of cosmic photons, though unrealized today in astrophysics. The energy scattering from the photon stream is, in principle, the same as synchrotron radiation recognized today in particles of matter undergoing deviation from straight-line paths at high speeds. Such sub-c particles, though, regain lost energy when initial conditions are reestablished. (The net loss and regain are effected over their breathing cycles, as explained in detail in Sittampalam 1999, Chapters 2 and 4.) On the other hand, however, photons, non-breathing as they are, do not recoup lost radiatons back into the fold.

Thus, the very much deviated and squeezed-out stream of cosmic photons entering solar space arrives "tired," or lower in energy content per photonic length λ_o, compared to their local counterparts; and *every single wavelength* in the extragalactic energy stream extends and appears redshifted to detectors in solar space. That is, even light from a relatively approaching body will have its Doppler blueshift overwhelmed by this redshift effect after a certain cosmic distance of travel toward us. (Any recessional motion of source, of course, would show up as increased redshift.) See also Rees 1997, p. 36.

In other words, statistically, the number n will always be smaller in any photon coming from the far galaxies in relation to a corresponding photon from a local source. And from Equation (7.4), we readily see that when n drops, λ extends, or redshifts.

Thus, we may conclude, a spectral redshift *does not* tell us anything specific about a cosmic body's state of motion or its distance relative to us. (Relative distances of the far galaxies may be very approximately inferred, though, from their redshifts, but not their speeds.)

One more illustration here should help to totally elucidate the principle. There are two persons, A and B, at rest. A fixed distance separates the two. A sends out a light flash every second. B times it and says he is receiving the signals at one per second. A now moves away from B but maintaining the flashes at exactly the same rate. B now notes the flashes to arrive at a longer than the one-second interval due to the extra length the successive flashes have to travel from A to B. This stuff is quite simple and elementary for us to understand in absolute space and time.

Consider, next, two distant galaxies at different points in the sky. Let them be equidistant from Earth. Two identical stars, one in each galaxy, blow up in a supernova. If the galaxies are both at rest relative to the Earth, no difference would be seen in the two events. They would rise and fall in intensity in equal periods.

We now know that galaxies have very large velocities through cosmic space (as they move between their cosmic centers of regeneration; see Section 9). Therefore, the speed and direction in which our two galaxies move in space will generally be different. Let one galaxy move in our general direction and the other move away. Next, let there be two identical stars, one in each galaxy, and let them both undergo the supernova explosion at the same time.

Now, the bodies are identical in every respect (and, therefore, of the same intrinsic brightness). They are also equidistant from us at this point in time. However, the supernova moving toward us will definitely look brighter and be of shorter duration than the other moving away. That is, being very distant objects, each will show a redshift whatever be its speed and direction relative to us; but the redshift of the one approaching us will be smaller than the one receding from us due to the Doppler effect.

Is this how Earth observers interpret such a happening today? No. The galaxy containing the fainter supernova is interpreted as receding very much faster and, therefore, based on the Hubble law (Peebles 1993), is very much farther. In some cases of such observations recently, they have even come up with the "conclusive findings" that the cosmic expansion is not slowing down or even constant, but accelerating (Zimdahl 2001)!

Photons, therefore, carry traits of their history, unlike atoms. Hence, whatever be the distant object—moving or not—the farther it is, the greater will be the redshift of any of its energy reaching us. In principle, therefore, the ultimate signals we may receive even from quasars lying at the extremity of our observation will have effectively redshifted, only to appear to us as the CMB. (Even gamma rays originally emitted by such objects will appear thus to us.) Hence, it cannot at all be concluded from any such observation of "emptiness" that we are indeed looking at the edge of space (or a region corresponding to the time of the "Big Bang") where there would be no matter. In other words, our observations have bounds, a physical limit. No matter how advanced our instruments and techniques are now or at any time in the future, all celestial bodies beyond a certain critical distance from us will fail to produce a signal above the CMB.

8. Dark Matter and Black Holes

The nature and extent of the dark matter (or missing mass) constitute one of today's major astronomical puzzles. While the conjectured dark matter haunts the outer regions of galaxies and galaxy clusters, the equally murky and speculative black holes lurk at the galactic centers (Peebles 1993; Rees 1997).

8.1. Dark Matter

The basic evidence for dark matter is that the stars and gas clouds around galaxies move surprisingly fast. Astronomers expected to find any gas swirling in the outer fringes of a galaxy to move more slowly than the gas closer to the center. Their reasoning, naturally, was that a body of matter should slow down as one went farther from the orbital center if it is to survive as part of the system, that is, without getting thrown out under the centrifugal effect. (In our solar system, for instance, Pluto travels slower than the Earth.) Much to their surprise, they found the velocity of the gas to be a constant, whether it was near the rim of the galaxy or well inside. At first, they thought this peculiar result was unique to the Andromeda galaxy (our closest neighbor) where the phenomenon was first detected. Then they systematically began to analyze hundreds of galaxies and found the same curious result. It prompted theorists to speculate a heavy invisible halo to surround the galaxy (just as we would have to infer a heavy invisible shell outside the Earth's orbit but inside Pluto's if the two planets were to have the same orbital speed). This constancy of velocity of a rotating galaxy is now a universal fact of galactic physics. And the conclusion today: dark matter is here to stay!

Another piece of evidence for dark matter comes from

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galaxy clusters. It is now confirmed that speeds of individual galaxies are so high that the clusters they constitute would fly apart unless they were being held together by a considerably greater force of attraction than the gravitational pull of their visible masses; this being the case even if each galaxy were to have the mass required to hold itself together as it rotates. And the conclusion here: there is *extra* dark matter present in galaxy clusters!

In drawing such inferences, we use our standard theory of gravity, which, in this context, reduces to Newton's inverse-square law. This law, which assumes that gravitational action springs from inside matter, has been directly tested *only within our diminutive solar system*. It is a sheer leap of faith, therefore, to apply it on scales several orders of magnitude larger. And this is where our renewed universal perspective comes in to beautifully simplify matters again: *There is absolutely no so-called dark matter anywhere in the universe.* Nuclear fission is the primary energy-producing reaction in all stars and galaxies; and fusion, though considerable, is only the consequential secondary. (Fusion does rule supreme—but at a much greater level of mass centers from which quasars are born—as we shall see in Section 9.)

In every star, galaxy, galaxy cluster, and galaxy supercluster, the net nuclear decay of matter increases from a dense center, through a sparse halo, to a final peak in a corona. And it is the *backpressure*, or inward radiation, from this radioactivity that pushes in any orbital matter and keeps it in check within—mimicking an increased gravitational tug from the center. The outward radiation drives the stellar or galactic wind of subatomic particles; from the Sun, we call it the solar wind. [In the Sun, typically, the intensity of radioactivity, predominantly the final-stage neutron decay, peaks at the outermost region of the halo, effectively forming a shell, or corona. The sub-c exhaust from the solar corona will thus consist mainly of the neutron-decay mass particles, protons and electrons. The speed-c exhaust of electron antineutrinos from the same decay process together with the electron neutrinos from the secondary fusion reactions (that take place under the backpressure of decay) will thus predominate the Sun's countergravitational field. It is the momentum of these outward neutrinos that rapidly accelerate and sustain the supersonic speeds of their own siblings, the sub-c mass particles, to the ends of the heliosphere. The backpressure from this strong and ubiquitous coronal discharge goes also to contain and regulate, over the eons, the fission reactor within. The inward winds from our local star cluster and the Galaxy predominate the (sub-c) cosmic rays that we now detect. Thus, in general, cosmic rays have their origin in the halos of stars, galaxies, and clusters thereof. The photons and neutrinos associated with the origin of these mass particles contribute to the CMB in the long range. In the short range, though, they tend to cause subtle variations in this otherwise isotropic CMB field. The proton and the electron discharged from the corona go eventually to combine and form the atom of hydrogen—to make hydrogen the most abundant element in the cosmos. Hydrogen is thus the main *exhaust* product of stars and galaxies and not their prime fuel, as posited today.]

8.2. The Physics of Galaxies

Low ambient pressures promote nuclear fission just as much as high pressures aid fusion. [As experiments continue to confirm, atomic properties, including radioactivity, do depend on the environment. This hard empirical fact would also now call into question, to say the least, the premise on which measurement standards are based today (Golub and Pendlebury 1979; Kerr 1999).] In the galactic halo, pressure and density drop with increasing radius. The drop in pressure steps up radioactivity but the drop in material density tends to nullify any increase in the decay intensity. Consequently, the vast outer region of a galaxy tends to be more of an energetic, dense, and homogeneous plasma medium than what we have come to believe this "empty" space to be. At these great distances, of several orders of light years from the galactic center, the gravitational effect (that is, from CMB shielding) is small in relation to the net inward push of the decay radiation. The latter being also a pro-gravitational influence, stable orbital speed, too, becomes correspondingly large for the region (see also Sittampalam 2003, The Galaxy).

Furthermore, orbital bodies of the galaxy are created by the "lawn-sprinkler effect": The core spews out stellar matter (periodically, as in the nova) while at the same time spinning about its axis. As such, the gases and stars streaming through an essentially homogeneous outer medium will have the same (terminal) speed irrespective of individual masses—just as much as electrons and nuclei of vastly differing masses have the same speed in the solar wind near Earth space (see Sittampalam 1999, Section 4.03, where this is also discussed quantitatively). En route from the birthing ground to the outer regions, of course, the bodies would be decelerating (toward terminal velocity) from the high (escape) velocity attained at ejection. The galaxy cluster and the galaxy supercluster evolve in very similar ways but from much larger nuclear centers, as we shall see in Section 9.

8.3. Black Holes

The black hole is a well-known prediction of general relativity. As physicists today believe, it is the ultimate state of a massive, dying star collapsing under its own gravity—to an infinitesimal point particle. Not stopping with itself, the black hole also sucks in everything else, including photons, from the region around. The exceptionally high outpouring of intense radiations observed today from quasars and other active galactic nuclei (see Section 9) are often cited as the "unequivocal evidence" for the existence of black holes. (Otherwise inexplicable today, such prolific energies from a source are considered the radiation from matter heating up as it spirals into a central black hole; see Hawking 1988.)

The insatiable hole may now be completely filled with the very same observational facts that now suckle it. The black hole thereby shall remain buried and outlawed from the nonfictional cosmic range for all time.

As we saw above, the high orbital speeds observed in the outer fringes of galaxies have now a simple and straightforward explanation. It also tells us the absolute force field of the classical vacuum, and thereby pressure, to be much higher in the outer regions of any galaxy than conventionally reckoned. Therefore, since pressure is transmissible, the absolute pressure of the vacuum in the inner regions, too, will be that much greater for the galaxy. Consequently, nuclear fusion of matter in the galactic hub becomes considerably high, making the total radiation (from fission and fusion) and body speeds to be much greater in the innermost regions as well. (This also makes the net nuclear breakdown

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of matter to be least at the galactic center, where fission and fusion would peak alternately over a cycle; Sittampalam 1999, Section 1.15). Not surprisingly, astronomers today are perplexed at the sheer intensity of the radiation, including gamma rays, emanating from such centers. But their popular interpretation today: A black-hole monster feeds at the center (Kaku and Thompson 1995)!

A huge, diffuse cloud of gamma radiation surrounding our Galaxy, too, is another well-verified fact of observation today (Dar and Shaviv 1995). But how can such energy get produced in what looks like empty space? Yes, it now affirms nuclear decay, and subsequent nuclear encounters, of galactic matter in these seemingly desolate outbacks. (The gamma-ray bursts from outer space, another great enigma to astronomers and astrophysicists today, can thus have their origin partly in our Galaxy's vast halo; see, for instance, Briggs 1996. The highly redshifted ones, suggesting enormous distances, are generally due to source recoil away from us as the photons get beamed toward us; see, for instance, Mészáros 1999.)

The effective diameter of the galaxy can thus be several times larger than that of its opaque aggregation, like the overall atom with respect to its nucleus and orbital electrons.

With such pieces of the grandest jigsaw puzzle all in hand, we venture next to piece the final cosmic picture together.

9. The Structure of the Universe

Man, through his microscopes, perceives in the atom a semblance of his solar system. Through his telescopes, he also observes a likeness of that solar system in his galaxy; his galaxy as a miniaturization of the local spiral group of galaxies; and so on, as worlds within worlds within worlds. . .

And through his logical reasoning, which is but a consequence of that same natural order of things of the universe, it should not seem incongruous to the average human mind that our own locale of the cosmos, too, is yet another extended image of that lowly atom.

This cosmic region of ours, one among many in the observable universe, would thus have a proportionate central matter—a cosmic core—as the nucleus, and layers of galaxy superclusters as the "electron" cover or shells (see also Sittampalam 2003, The Cosmos). There is evidence in abundance today to support such a model, but it is in the form of a giant jigsaw puzzle in disarray. The pieces, nonetheless, are all there now; but the picture, the ultimate structure and form of the universe, is not that readily recognizable; it is even fuzzy to astrophysicists.

Here, we shall fit all those pieces together systematically. Some essentials of the overall and final image have already been glimpsed at in sections past. Here, we shall also fully complement and substantiate them. The exercise, though, should seem but a high school project in physics.

9.1. The Latticework of the Observable Universe

Astronomical observations reveal the fact that the large star ends its active life in a spectacular supernova. The ejected matter from such exploding nuclear bodies then go to form a new generation of smaller stars. All these star types we are able to directly observe as discrete bodies in the firmament and thereby make these correct inferences (see, *e.g.*, Peebles 1993).

It is also not inconceivable, therefore, that the large stars we see today were themselves once ejected from even larger nuclear entities—the galactic cores. But it is not possible, even with the best of instruments, to observe the galactic core directly to ascertain this process. Whereas the supernova debris eventually clears to reveal a core, the fog around the galactic center never lifts. As a result, the nucleus of our own Milky Way Galaxy, for example, remains obscured at all time by the stars and the gas clouds of what we call the central bulge. This shroud never dissipates due to the relentless activity within, which feeds and sustains it. Nevertheless, recent endeavors have revealed to refined instruments and observational techniques enough evidence to show that the region of the galactic core is indeed a hub of violent activity of *sustained* star formation (Serabyn and Morris 1996).

Not so long ago, the central bulge was commonly thought to consist mostly of very old stars. But, now, there is also convincing evidence to suggest that star formation has been occurring near the center of the bulge throughout the lifetime of the Galaxy. Thus, the most energetic of expulsions from the galactic core are what we see mostly as stars and star clusters outside the bulge today.

Extrapolating back in time, a very close or contiguous union of such galactic cores (that is, in their extremely active and formative years) is what we observe, in time lapse now, as the quasar. Quasars and their ilk, collectively known as active galactic nuclei, or AGN, are the greatest cosmic powerhouses known today. The AGN, in turn, would evolve from even larger and denser mass centers. The existence of such super centers, though, is not presently recognized, suspected, or even speculated.

Let us here refer to these ultimate mass centers, dispersed across observable space, simply as *cosmic cores*.

Due to the cover provided by the AGN outside, cosmic cores, too, remain out of direct view like galactic cores. But here, too, indirectly, there is ample evidence to support such centers in our observable universe. For example, the cosmic cores would possess most of the mass in our universe (like atomic nuclei do in a body of matter); and it is only such extremely massive and compact bodies (in the foreground) that could possibly account for the otherwise enigmatic gravitational lensing of (distant) quasars (Fischer *et al.* 1994).

But what would be the true function of cosmic cores?

To astronomers and astrophysicists, especially, the function of cosmic cores should not seem something that is at all new. Even this aspect of the cosmic process is seen today in miniature down the line. We say that large stars die in the supernova and generate new stars. But the first part of this statement we also know is not generally true. That is to say, the remains of a so-called dead star would live again—for a repeat death performance another day—if the environment is right: The dense and extinct core, typically, a neutron star, exerts an enormous gravitational pull on all that is around in the vicinity (Sittampalam 1999, Section 1.03) and grows by accreting matter; in time, it would eject matter in a nova- or even a supernova-like event once again. In principle, therefore, there is no end to these epochs for the selfsame stellar core—if sufficient matter is (cyclically) provided. In the case of the cosmic cores dotting our universe, however, there just happens to be sufficient matter around (from an initial condition) to keep the process going indefinitely.

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9.2. A Universe of Steady State

In actual fact, the cores of the cosmic latticework feed each other. That is, they accrete matter, fuse them together, and toss them out at each other. Matter, from the galaxy supercluster to the atom, is thus continually recycled in our observable universe. And the cosmic species of the heavens continue to live on in their eternal splendor.

Evidence for this grandiose and cyclic mass transfer through cosmic space, too, is very well established now, though it remains a challenge to today's standard model: The periodicity of birth of galaxy cluster groups and the uniformity of their spacing and speed are truly breathtaking that they even make the observers to double-check their instruments in disbelief (Smoot and Davidson 1993; Matthews 1996)!

It is thus plainly seen that galaxies are not scattered more or less randomly through space as had once seemed the case. Indeed, galaxies are aggregated as sheets of clusters and superclusters. It is like a cosmic foam where the walls of the bubbles are concentrations of galaxies. As a balance to these huge concentrations, immense voids also exist between sheets (Saar *et al.* 2002).

Furthermore, as NASA's Hubble Space Telescope (HST) continues to confirm only too overwhelmingly, galaxies abound even at the deepest levels of observable space. Not only did the HST capture new galaxies in earlier "empty" space, but it also got a better look at some of the lumpy ones that had been seen before. Seen in the infrared, they look more like "normal" galaxies, like those in our own cosmic neighborhood. Clearly, cosmic structures do not seem to have changed over time across observable space—as if in a steady-state universe (see, for instance, Schilling 1999).

The concept of the conservation of energy would also suggest a steady-state universe. Until only as recently as a decade ago it was difficult to reconcile all of the observed data to a steady-state universe. But, now, the powerful telescopes of the present day throw to us much more light than they receive. And, in this most revealing new light since the time of Einstein, we see the awe-inspiring final picture emerging.

Every celestial body has a closed-loop trajectory beginning in a cosmic core and ending in a neighboring one only to be regenerated, or, to be born again. And a steady-state universe would go on existing under the setting (eternally fueled by the radiaton—as the perpetual motion machine of The First Cause).

9.3. The Genesis of Celestial Bodies, in Summation

• The observable universe is an extension in three-dimensional space and one-dimensional time.

• This universe of ours is dotted with enormous nuclear centers, or "cosmic cores," where fusion of matter prevails.

• The extremely dense cosmic cores are akin to atomic nuclei in a stable yet vibrant solid medium.

• Mass-energy is continually exchanged (recycled) between cores of the cosmic latticework in an unending saga of "little big bangs" and "little big crunches" at the cores.

• We inhabit a relatively placid region surrounded by, but far removed from, cosmic cores. (We would not have evolved to the stage that we have in a region close to a cosmic core: The violence and the intensity of radiation would be far too great and the time scale far too small for most life forms, let alone for the current stage of their evolution.)

• Each cosmic core accretes matter only to fuse it (in a slow crunch) and eject it out (in a hasty bang).

• The cosmic cores thus incessantly feed each other in a now observable steady-state universe.

• The highly fused ejectum from the core expands out in an arc as it speeds away from the center at or above escape velocity. We see this early stage of cosmic evolution as a close group of quasars—the progenitor of the galaxy supercluster. (Even if it be outside our field of study, do we not ever wonder why galaxy clusters are periodic and fly in formation at mind-boggling speed—our Local Group, for instance, at six hundred kilometers per second, or more than a million miles per hour! See, for instance, Smoot and Davidson 1993 or Peebles 1993.)

• Quasars and their ilk are collectively known today as active galactic nuclei (AGN). These are the greatest nuclear reactors of all next to cosmic cores. Detected today ever increasingly by modern instruments, AGN brilliantly dot enormous cloud complexes that are but the time images of incipient galaxy superclusters.

• Nuclear fission is enhanced in a low-pressure medium, just as much as fusion is promoted by high pressure.

• The high speed of expulsion from the cosmic core takes the ejected nuclear matter into the thinning outer regions.

• In the speeding ejectum, each large lump, which is the quasar, splits into halves in succession.

• The process of bifurcation of the quasar goes on until the fragments—individual galactic nuclei—come within the size limit determined by the regional field pressure the nuclear lumps are engulfed in.

• The single quasar thus splits successively and evolves into the galaxy cluster. And the single core ejectum, generally consisting of a group of quasars, transmutes as the galaxy supercluster.

• The supercluster is thus a fast moving shell of matter expanding radially from its core of origin. Distant superclusters will thus appear to be perched on enormous bubble-like voids.

• Being periodic ejections from the mother core, the supercluster siblings will be equally spaced. The space between them will also be the most devoid of matter in the cosmos. (The sheer uniformity of these spacings observed today is even amazing to astrophysicists and remains a challenge to their standard model.)

• Bifurcations generally taper off for the AGN as the ambient field pressure levels off. In this vast mid region between cosmic cores, the galaxies stabilize, but the nuclear activities of individual galactic cores continue.

• Superclusters and clusters of galaxies are thus not cosmologically recent epochs as generally believed today.

• The cosmic cores form the reference ("rest") frame for the Cosmic Microwave Background radiation that we now detect.

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• Veiled by the quasars outside, cosmic cores escape our direct observation. This is akin to the galactic core being masked by the stars of the central bulge.

• Again, the single quasar, moving through the thinning region away from the cosmic core, successively bifurcates to form a group of galactic cores. The group of galactic cores goes to form the galaxy cluster.

• Each galactic core, in turn, spews out matter periodically, spawning the stellar cores.

• Each of the larger stellar cores bifurcates successively to form the star cluster. The last of these separations that fell just short of escape velocity are what we now see as binaries, ternaries, and so on, in the mature star cluster.

• In summary: Stars are generally found in clusters; the star cluster transmutes from the (large) stellar core; stellar cores are derived from the galactic core; galaxies are generally found in clusters; the galaxy cluster transmutes from the quasar; quasars are generally found in clusters, or groups; the galaxy supercluster transmutes from the quasar group; and quasar groups are derived from the ultimate cosmic core.

• What worlds the latticework of cosmic cores extend into are beyond observation and, hence, beyond the scope of physics.

• Galaxies and stars, therefore, are born primarily by fragmentation—and not by agglomeration as popularly believed today.

• Planets and moons are basically stars, or star fragments, that cooled off faster due to their small size. Their molten cores are thus nuclear where net fissioning of matter would continue to varying degree.

• Nuclear fusion is thus the primary reaction only at the cosmic cores; and fission predominates the scene everywhere else down the line—in quasars, galaxies, stars, planets, and moons.

• We are today speeding away from the cosmic core of our birth (in a highly fused and low-entropy state)—at more than a million miles per hour through absolute space, the space of the CMB—toward the cosmic core of our demise (in a highly fissioned and high-entropy state).

• And the cycle repeats.

9.4. The Arrow of Time

Cosmologically, multiple and recurrent "small big bangs" followed by "small big crunches" would be the viable and Newtonian model for our observable universe. We see in the preceding subsections not only the logic but also the observationally verifiable logistics of these events. Galaxies and stars, therefore, are primarily formed by fragmentation and not by agglomeration as has been the popular belief to date. And we earthlings are moving in spaceship Earth from a tempestuous bang and into an equally calamitous crunch. Life, as we know it, can exist only in the relative tranquil and calm of the short interlude of space and time well between the two extremes.

Entropy at the cosmic cores of origin and demise is low due to the highly fused state of matter therein. Following a bang, the prime galaxy supercluster matter emerges from the core with high acceleration. Deceleration soon sets in and entropy starts its rise as matter undergoes bifurcation and general nuclear disintegration through the vast and thinning space away from the core. Halfway through its cosmic vault, the matter starts to accelerate gradually toward its radially dispersed centers of destination. By this time in the highly rarefied cosmic space, the stars and galaxies constituting the matter are all in middle age. General dotage eventually sets in as the matter races toward its destined cores. When the matter finally sets with a crunch at those cores, the entropy drops sharply back to its original value. And entropy change zeros out for the cosmic matter between its recycling centers.

We, the inquisitive observers, are now decelerating in absolute space, the space of the CMB, as also confirmed by the COBE instruments (Turner 1993). Cosmologically, our life span as biological species is a very short one and well removed from cosmic cores. And the nuclear disintegration of matter in our Galaxy and consequent entropy rise for the local region during this our odyssey between two recycling centers would, typically, give us the direction to the arrow of time.

The group of galaxies we belong to is thus in a space somewhere between, but well outside, two cosmic cores— speeding away from one and toward the other. Due to its deceleration, our Local Group is still from reaching the halfway mark. High overall stellar activity and entropy rising toward a maximum still remain the Group's order of the day. And the average separation of galaxies, for instance, would serve as an age indicator for our Group in relation to other such evolving groups.

And what, pray, would lie beyond all these cosmic recycling centers in a Newtonian paradigm?

To the physical man, the conditions at the extremities of space and time are beyond observation. Therefore, they will remain always speculative. The original cause for mass-energy and its asymmetry of movement (a nonvanishing linear momentum coupled with a nonvanishing angular momentum) is outside the realm of physics. Therefore, they will remain always metaphysical.

But, then: We see the order of things in and around us and call it the natural order. And this observational domain of ours is finite. That is to say, the space and time of our observation have bounds. Therefore, at the extremities of our space and time, our natural order would interface with another order (or series of orders). And all that is outside our observational limits will then be explained by this outside order, or: extranatural order. In the realm of this extranatural order, the fundamental physical laws, and hence the physics and the logic, will be different to our own—since the extranatural order would account for all that is beyond our finite order. In other words, the extranatural order will be superior to our natural order, or: a supernatural order.

The radiaton of our observable order interfaces with this unobservable outside order. In other words, the radiaton bridges the gap between the natural and the supernatural. And do we not also glimpse in the radiaton what we would call an extension of the supernatural, or an attribute of godhead: Perfect and eternal; of energy transcending space and time and even human comprehension; encoding very possibly the secrets of life and of the mind itself; bridging the abyss between the natural and the supernatural—a truly "God" particle?

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10. Discussion and Conclusion

The flat-earth and the geocentric societies all had to change their views with increasing hard data. On larger scales, the world turned out very different to what they had extrapolated it to be from their cozy little cocoons earlier. In a like manner, Einstein's general relativity, the current theory of gravity, has now seen better days of its usefulness. At the time it was conceived (1907-1915), hardly anything was known of the movement of celestial bodies outside of just our planets and moons. Galaxies were not even known then to exist, to say nothing of quasars and migrating galaxy superclusters. Galaxies, for instance, became an observational fact only in the 1920s. Is it any wonder at all now that galaxies and clusters thereof do not follow the same gravitational law that is seemingly applicable to the minuscule solar system?

At the frontier of quantum mechanics, too, the situation has not been getting any better, with the number of "elementary" particles diverging in count instead of whittling down toward the ideal unity. What's more, these two halves of physics, relativity and quantum mechanics, are at constant loggerheads with one another with nary a hope of ever reconciling them into a single union (Hawking 1988).

Increased observations on both these hemispheres of physics, however, have now redeemingly guided us to final unification. With a wide scope to embrace the entire order of things, the nature of things has indisputably become simple and classical mechanical in interpretation. Indeed, the entire universe of our observation is now seen as a voidless continuum in mass-energy: The stars, the atoms, and the classical void are all literally part of a single, seamless whole—as at triple point! (See also Sittampalam 2003, Mass-Energy.)

Phenomena can no longer be considered in isolation on either of these hemispheres of physics for our explanations to be truly consistent across the realm. In stark contrast, theories to the present day were conceived in pockets and are ad hoc, the root cause for their increasing incompatibility today. Black holes and dark matter are nonentities; so are Coulomb charges and magnetic monopoles. These are but typical of the constructs of the stopgap and patchwork theories unduly dominating our thinking today.

10.1. The Motivation for the New Speculation

Old notions die hard; but die they must, especially in physics if it is to evolve as a science. Physics has been stuck for most of the past century with controversies and contradictions in the face of increasing and improving data. And it has indeed been an unprecedented century of startling discoveries of the world in and around us. Our inner vision to coherently interpret the new data, though, has not kept pace. Lamentably, increasing specialization in ever-narrowing fields leaves researchers with little time to update themselves in other fields for a broader worldview. This blinkered approach to basic study is the root cause for the ever-widening gap between theory and empirical reality. And coupled with complacency, preconceived notions on the nature of things tend to hold sway over many great minds of our times despite the history of science. The continuing debates on fundamentals at the highest echelons in ivory towers basically say it all for this sorry, if not embarrassing, state of affairs in physics today.

All these were clear enough signs that something very fundamental was amiss here in the world of theoretical physics. A revisit now seemed only long overdue, especially in light of the overwhelming new data since the time of Einstein and Bohr. Beyond debate, invaluable human resources, too, could be rechanneled into more useful research when the basics are thus better known. These were the factors that motivated the rethinking here into the rudiments of nature. The investigation was to be unbridled by modern physics (which has disturbingly given up the quest for causation) and bereft of preconceived ideas that seem so ingrained in many of us. It was to be armed only with the well tried and tested tools of classical mechanics which has taken man to the Moon (that, too, on short notice!) and brought him safely back home again. Not surprisingly, the speculation that emerged from the new findings gained strength as it grew to become the final and singular theory for the whole of physics.

The motivating factors notwithstanding, however, the underlying and burning conviction all along has been: The First Cause would not have had material or design constraints when it came to creating what we observe as our universe. One material entity alone would have sufficed, profusely tossed out with a spin. And, voilà! We have nature.

10.2. What New Experiments Could Be Done to Test This New and Final Theory

The final theory propounded here is not something that is entirely new. In fact, it is reminiscent of the old "ether" theory. (In a way, this work is a tribute to the proponents of that theory of over a century ago—their intuition and gut feeling from everyday experience were not wrong after all!) The work here, however, takes the old ether concept a step further, to refine and to show that the universe is in fact an ether continuum where:

A. The classical vacuum is the ether in its "evaporated" state; classical matter is the very same ether material in its "condensed" form; and the ether itself is indeed mass-energy.

B. The smallest ether quantum capable of triggering detection in any material instrument corresponds to the photon's per-cycle quantum of energy. We have here named this absolute and truly fundamental quantum of analysis as the *radiaton*. The radiaton, therefore, is detectably the most elementary particle of nature. (In other words, anything that is fractional or more basic will not be physically detectable. It would, therefore, not concern physics.)

C. The radiaton has the classic attributes of a perfectly elastic particle; both mass and energy thus become intrinsic to the particle, that is, as mass-energy; and the particle serves also as the unique "binding agent" in the "new" physics.

A good way to test one of the many—well over a dozen—predictions of the final theory (Sittampalam 1999) will concern the electron-antineutrino flux from the Sun's coronal neutron decay. In this end stage of radioactivity, which peaks in intensity at the solar corona, the single neutron transmutes into a proton, an electron, and an electron antineutrino. As such, the flux of each of these subatomic products of decay will bear a constant relationship to one another at any given radius

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from the Sun. Hence, say, averaged over the rotational cycle of the Sun at the ecliptic, the solar electron-antineutrino flux would vary linearly with the solar electron or proton flux. (That is, the stronger the solar wind over a cycle, proportionately more intense will be the antineutrino flux over the same cycle.) Produced further within the corona are the electron neutrinos from the proton-proton fusions that take place under the backpressure of fission, reminiscent of the H-bomb. As such, this secondary solar electron-neutrino flux, too, would vary in intensity with the rest of the exhaust particles. (A corroborative report on the latter fact may be seen in McNutt Jr. 1995.)

It invariably takes the greater scientific community, however, to critically and conclusively verify any predictions of a physical theory. Most of the predictions of the final theory here may be tested with present-day instruments and in existing facilities, that is, with minimal cost. With these in mind, some of the predictions have also been posted on the web (Sittampalam 2003: NASA Tests, KamLAND Test, UCLA Test, and Two-Slit Tests).

10.3. Conclusion

This work has essentially been a mental probe—with full empirical backup—into our physical world, from the atomic to the cosmic. In light of the overwhelming new data since the time of Einstein, the whole of our observable universe is now seen literally as a vibrant and voidless single medium—and the way to unification in physics.

A simple action-and-reaction mechanism is seen to underlie all the physical processes in nature. Thus, we have unified not only all of the forces in nature but also all of her particles of mass and energy—in the radiaton, the mighty yet ordinary and, outwardly, uncomplicated per-cycle quantum of the photon. Inwardly, it may well carry the secrets of life and of the mind itself. (This "software" that it carries, for its subtle environmental influence at submicroscopic range, is also likely to be a simple one—and the "chaotic" seed of biology. [Chaos theory is implied here. This theory forms a relatively new branch in mathematics. Processes that seem random or irregular, such as evolution, may actually follow very simple and discoverable laws. It is system behavior that depends so sensitively on the system's precise initial conditions that it is, in effect, unpredictable and cannot be distinguished from a random process even though it is deterministic in a mathematical sense.])

Thus, the last few decades, especially, have seen our insights into the nature of things turn into a panorama of unprecedented breadth, depth, and allure. Everywhere we now turn, deep connections and simplicity transpire to be the order of things at basic levels. Awestruck, one begins to note that the utter simplicity of basic mechanisms in nature is but a revelation of the greatness and the elegance of the eternal design, to which the work here bears full testimony. Even the most diehard skeptics of our times should find the revelations disturbing, if not annoyingly attractive.

Let us, therefore, take heart that the dark ages of physics, of black holes and dark matter, are to be no more. The flickering light of the space-time continuum now takes its bow from its limited kingdom and short reign—since a great and all-enlightening sphere to dispel the darkness for all time has been seen on the horizon.

It is the dawning of the age of the mass-energy continuum. Let us not shut our eyes or be complacent in our ivory towers and draw down the shades.

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About the Author

Mr. Sittampalam received his Bachelor of Science in engineering from the University of Ceylon in 1969. In the 1970s, he worked mostly in Montreal, Quebec, Canada, starting as a technical vocational teacher with the Montreal Catholic School Board; he entered industry in 1974 as an electrical engineer for P.M. Wright Electrical Co., Ltd., St. Laurent, Montreal. In the 1980s and 1990s, Mr. Sittampalam worked mostly as an engineering consultant on overseas projects for Texas-based project management firms such as Daniel (now Fluor-Daniel), Eagleton, and Petrocon. Project sites included the ARAMCO (Arabian-American Oil Co.) oil fields and facilities in Dhahran, Tanajib, Jubail, and Abqaiq, Saudi Arabia; and the Sirte Oil Co. (formerly Exxon-Esso) in Sirte, Libya. From October 2000 to the present, Mr. Sittampalam has been Director of Engineering for ElectroFlow Lanka Ltd. in Sri Lanka (a division of Canadian Offshore Investments Ltd.).

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Compiled by Eugene Mallove

"Europe Aims for Endless Energy"

Surprise, surprise, the headline of the news item from England's *The Guardian* (November 27, 2003), was not referring to the kind of new energy that *Infinite Energy* espouses. Science editor Tim Radford was reporting on the latest hint about where the International Thermonuclear Experimental Reactor (ITER) might be sited. In the south of France, no less. How ironic! That is precisely where cold fusion pioneers Drs. Martin Fleischmann and Stanley Pons were situated in the early 1990s, when Japanese funding had set them up in a lavish laboratory in Sophia Antipolis, near Nice. It is also near where the 11th International Conference on Cold Fusion (ICCF11) will be held in the autumn of 2004.

Radford wrote, "Ministers in Brussels gave the go-ahead yesterday for ITER, the world's biggest and most ambitious fusion reactor, at Cadarache near Aix-en-Provence. It will be 10 years in the making and, in its 20-year operating life, researchers will experiment with a kind of slow hydrogen bomb in the hope of extracting vast amounts of clean energy from tiny amounts of heavy water. . .Fusion's most ardent enthusiasts believe that a viable power plant is 30 years away. ITER is just another stage in the research." Yeah, sure, another 30 years—hot fusion is "the energy source of the future and it always will be."

Energy Bill Defeat Scuttles Grandiose Hydrogen Plans

The always alert Peter Hoffman, editor of *The Hydrogen & Fuel Cell Letter* (www.hfcletter.com), commented in his December 2003 issue, following the recent failure by Congress to approve a major Energy Bill:

Post Mortem for Defunct Energy Bill: It included $2.1 Billion for Hydrogen

Washington, DC—Whatever the problems were—and by many accounts, there were tons of them—with the giant 1,100-page energy bill that faded into oblivion at the end of last month, the 11-page section that dealt with hydrogen (Title VIII, p. 308-319) was lavish in its intent.

To be sure, the bill signaled intent only: it was a bill to "authorize" spending. Coming up with the actual money—"appropriations"—would have to be voted by Congress later on a year-by-year basis.

Nevertheless, the figures were stupendous: the grand total Congress was to have authorized over 5-years—2004 to 2008—was $2.149 billion, rising from an initial $273.5 million for fiscal year 2004 to $550 million for fiscal year 2008.

Among other things, the bill would have required the energy secretary to come up with a coordinated plan for the various hydrogen programs in the bill no later than 6 months after enactment.

Included in the goals is one that would enable automakers to make commitment to offer no later than 2015 "safe, affordable, and technically viable hydrogen fuel cell vehicles in the mass consumer market"; enable production, delivery and acceptance by consumers of model year 2020 hydrogen fuel cell vehicles and other hydrogen-powered vehicles with a range of at least 300 miles, featuring improved performance and ease of driving, higher fuel economy, and other requirements. . . [End of Hoffman citation.]

Perhaps some enterprising cold fusion/LENR researchers might have dreamed of flying "under the radar" and getting some of *their* research funded with that proposed hydrogen section of the energy bill? Not a chance—the *hot* fusioneers would have a better opportunity for such chicanery, but not much of a chance at that. You can safely bet, however, that conventional hydrogen energy, after the next U.S. presidential election in November 2004, is going to become the next big DOE energy research boondoggle. It will rival hot fusion in the magnitude of its stupidity and wastefulness.

No Need for "Dark Energy"?

The humorous on-again, off-again fortunes of the latest cosmology fad, "dark energy," were crystallized in a recent *New Scientist* news account, "Is Dark Energy a Mirage?" (December 6, 2003, pp. 10-11). On the cover of the issue the query was posed thus: "DARK ENERGY—Does the Universe need it?"

Here's the delectable lead of Marcus Chown's story: "Dark energy may not exist, according to an international team of astronomers who have used an X-ray satellite to count galaxy clusters in the early universe. If they are right, the expansion of the universe is not speeding up and the scientific community has been taken in by a huge cosmic mirage."

This "dark energy" tempest, within the context of the thoroughly unproved Big Bang theory and its attendant universe expansion hypothesis to explain the cosmic red-shift (one might call *that* the *ultimate* comic mirage), has been bubbling since 1998. It was then that studies of distant supernovae done at the University of California at Berkeley made some cosmologists think that the universe was accelerating in its presumed expansion much faster than had been thought. The "fix," to explain this hyperactive universe malady, was an anti-gravitating "dark energy." The latest clownish episode of the Big Bang story was born. Some 70% of the universe was said to be comprised of this unidentified, invisible "stuff."

The particulars of this latest reversal of the "dark energy" fad are unimportant; it's all in *Astronomy and Astrophysics* (Vol. 412, p. 35), in any event. Here's a real howler from writer Chown: "The biggest pay-off from losing dark energy is that physicists would no longer have to put up with an idea that does not fit with their theories." Marvelous! I told you that the nit-wits in the Physics Establishment were theory-driven and oblivious to unwelcome experimental data; now they've even got a journalist penning a preposterous line in which Science 101 is explicitly abandoned with no

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embarrassment at all. The writer notes that the Standard Model predicts that the energy density of dark energy would have to be 10^{123} times greater than observations allow, which Nobel laureate Steven Weinberg has said, according to Chown, is "the worst failure of an order of magnitude estimate in the history of science." Not so, Steve! That honor goes to you and your buddies' estimates in 1989 and thereafter that cold fusion/LENR reactions were *a priori* "impossible" by many tens of orders of magnitude!

Hint to Weinberg: Size is not important, but significance is. The integrity of science and our energy future is far more important than the counting of angels on pinheads that cosmologists (should we call them simply "comics"?) have been doing. Get real! Get experimental! Ah, but we learn the "dark energy establishment" is already fighting back against assaults on its new industry. What a joke on all of us this is.

Institute of Physics Press Release on Claimed New "Electricity Source" Within Water

We do yet not know the ramifications of this recently published technical work—it appears at first glance that a novel conventional physics effect is being hyped—but it is of interest that a mainstream physics organization in the UK is promoting the finding in such a bold way. *The Guardian* in England promoted the reports this way: "New energy source found in tap water." This does not mean, of course, that this research has the significance of, or any direct relation to, the anomalous phenomena frequently discussed in the New Energy field (and *ignored* by the Institute of Physics). It appears that other forms of energy are required to generate the electrical effect. Roger Highfield, science editor for *The Telegraph* in England wrote (October 20, 2003): "A typical setup using a ceramic filter and tap water can produce 10 volts and the current depends on the size of the filter. Since large water pressures are not needed, natural flows of water can be harnessed. These could include tidal water flows, underground aquifers, dammed water, drinking water currently being filtered by utilities companies to improve its clarity, and rain falling from roofs."

Here is the full text of the IOP's October 20, 2003 Press Release:

Let water power your mobile phone: scientists discover new source of electricity

A new way of generating electricity from flowing water could mean that in the future you will never have to charge up your mobile phone again. Instead of a normal battery, mobile phones could be fitted with a battery that uses water —you just need to pressurise it regularly.

Research published today by the Institute of Physics journal, *Journal of Micromechanics and Microengineering,* reveals a new method of generating electric power by harnessing the natural electrokinetic properties of a liquid such as ordinary tap water when it is pumped through tiny microchannels. The research team from the University of Alberta, Edmonton, Canada, have created a new source of clean non-polluting electric power with a variety of possible uses, ranging from powering small electronic devices to contributing to a national power grid.

The research was led by Professor Daniel Kwok and Professor Larry Kostiuk from the University of Alberta. Professor Kostiuk said: "This discovery has a huge number of possible applications. It's possible that it could be a new alternative energy source to rival wind and solar power, but this would need huge bodies of water to work on a commercial scale. Hydrocarbon fuels are still the best source of energy but they're fast running out and so new options like this one could be vital in the future."

He continued:

"The applications in electronics and microelectronic devices are very exciting. This technology could provide a new power source for devices such as mobile phones or calculators which could be charged up by pumping water to high pressure. What we have achieved so far is to show that electrical power can be directly generated from flowing liquids in microchannels." The key to electrical power generation is to create a sustainable electrical charge separation. The physical phenomenon involved in this research is the charge separation that occurs at solid-liquid interfaces due to the dissociation of the solid. As a result, the surface becomes charged and opposite-charged ions in the liquid are attracted to it; while like-charged ions are repelled, resulting in a thin liquid layer with a net charge. This region, known as the Electric Double Layer (EDL), ranges from several nanometers to a few micrometers thick, but is the primary mechanism for charge separation. The research team constructed a solid-liquid interface as a channel with a diameter similar to the EDL and forced the liquid through this channel, the net charges in the EDL are transported downstream. This preferential transport of one type of ion will create a current, and hence voltage difference across the ends of the channel if the solid is non-conducting. When an external electric circuit is added by placing electrodes at the ends of the channel, then electrical energy is extracted as current flows between the electrodes. The source of that energy is the work done to push the liquid through the channel. Although the power generated from a single channel is extremely small, millions of parallel channels can be used to increase the power output.

(The paper, "Electrokinetic Microchannel Battery By Means of Electrokinetic and Microfluidic Phenomena." by Jun Yang, Fuzhi Lu, Larry W. Kostiuk and Daniel Y. Kwok is published in the Institute of Physics journal, *Journal of Micromechanics and Microengineering*. It is published at http://stacks.iop.org/JMM/13/963. The journal's homepage is http://www.iop.org/EJ/JMM.)

The Institute of Physics is a leading international professional body and learned society with over 37,000 members, which promotes the advancement and dissemination of a knowledge of and education in the science of physics, pure and applied. It has a world-wide membership and is a major international player in: scientific publishing and electronic dissemination of physics; setting professional standards for physicists and awarding professional qualifications; promoting physics through scientific conferences, education and science policy advice. The Institute is a member of the Science Council, and a nominated body of the Engineering Council. The Institute works in collaboration with national physical societies and plays an important role in transnational societies such as the European Physical Society and represents British and Irish physicists in international organisations. In Great Britain and Ireland the Institute is active in providing support for physicists in all professions and careers, encouraging physics research and its applications, providing support for physics in schools, colleges and universities, influencing government and informing public debate.

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MIT Tech Talk Lauds *The Economist* Magazine's MIT-Trained Journalist

The Economist magazine's energy and environment correspondent, Vijay Vaitheeswaran, was the focus of a piece by Nancy Stauffer, of MIT's so-called Laboratory for Energy and the Environment, in MIT's administration newspaper, *MIT Tech Talk* (December 3, 2003). To our knowledge, neither Ms. Stauffer nor Mr. Vaitheeswaran has had any interest in covering cold fusion/LENR happenings connected with MIT, such as the recent ICCF10 meeting just a few blocks from the "Laboratory for Energy and the Environment." Here are some of the ironic passages penned by Ms. Stauffer:

"Vijay Vaitheeswaran's MIT education prepared him well for his career as a journalist. He learned to be skeptical—an outlook that serves him well in his job as energy and environment correspondent for *The Economist*.

"'When people try to parade fancy ideas and visions that are going to change the future, it's my MIT training that keeps me grounded not to believe most of what is said,' he told an overflow audience of MIT researchers, students and Knight Science Journalism Fellows crowded into a conference room for a Friday afternoon lecture hosted by the Laboratory for Energy and the Environment. . .

"Using the example of hydrogen fuel cells, one of the topics covered in his new book, *Power to the People,* Vaitheeswaran said some people see it as the 'great hydrogen hoax.'. . .[but] the hydrogen fuel cell car of the future may be a possibility, as long as you don't paint your car with rocket fuel, he said [a reference to the suspected cause of the 1937 Hindenburg Zeppelin's explosion and fire].

"Other people view hydrogen fuel cells as an economic hoax, arguing that hydrogen is not an energy source; you have to make it from something else, so it's in efficient and expensive," Ms. Stauffer intoned. And, indeed, that is correct. *Conventional* hydrogen use is as an energy *storage* medium, period, not as an energy source per se.

What was the illustrious *Economist* reporter's angle on that very real shortcoming of *conventional* hydrogen fuel cell energy? "You have to make electricity from something, but as a society we clearly find it worthwhile to have electricity. Otherwise we'd have a cow-dung fire in the middle of this room." How perceptive! Amazing! The audience, no doubt, hung on his every word—all the while contemplating how they were going to get their pet boondoggle project covered by *The Economist* via Mr. V. You can be very sure that not a single person in that room of "science journalists" and academic power brokers on the Federal energy research dole will ever write a single half-legitimate sentence about truly *new* energy, until it is *forced* upon them. Then they will proclaim that it is *they* who brilliantly got "the scoop". . .

MIT *Technology Review's* Response to ICCF10

None of its editors could be persuaded to attend the 10th International Conference on Cold Fusion near and at MIT last August 24-29, but they found the time and energy to comment on *TR*'s website about another local university's very incremental discovery that was reported in the *Boston Globe* and in one of *Nature's* specialty publications:

Bacteria Make More Electricity
Technology Research News (October 6, 2003)

One solution to humans seemingly insatiable appetite for energy is to let bacteria do most of the work.

Researchers from the University of Massachusetts at Amherst have identified a microorganism that is particularly good at converting sugars to electricity under natural conditions.

The researchers used the organism in a simple, clean microbial fuel cell. Fuel cells generate a flow of electricity by pushing electrons out one electrode and receiving them back through a second electrode.

The UMass-Amherst researchers showed that the marine sediment bacterium Rhodoferax ferrireducens can directly transfer to an electrode the electrons generated as it feeds. This makes for a fuel cell that is 80 percent efficient at converting the energy locked up in sugar's chemical bonds to electricity, compared to 50 percent for previous microbial fuel cells.

The bacteria feed on glucose, which is the main form of sugar in the environment; fructose, which is common in fruits; sucrose, which is contained in sugar cane and sugar beet; and xylose, which is found in wood and straw.

The bacterial fuel cell generates about 100 times less power than today's hydrogen fuel cells. This gap can be narrowed by improving the electrode and by genetically modifying the bacterium, according to the researchers.

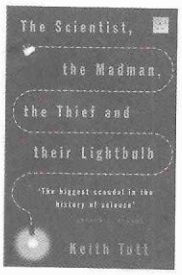
It will take a year or possibly considerably longer to develop a practical microbial fuel cell, according to the researchers. The work appeared in the September 7, 2003 issue of *Nature Biotechnology*.

Winston Churchill— Wisdom for Our Time from the Past

"The truth is incontrovertible, malice may attack it, ignorance may deride it, but in the end; there it is."

The Scientist, the Madman, the Thief, and Their Lightbulb

by Keith Tutt



This is the U.S. release of the book originally titled *The Search for Free Energy*. Tutt presents the many new energy/free energy inventors of the past 100 years, from Nikola Tesla, to Stanley Pons and Martin Fleischmann, to Randell Mills and Alexandra and Paulo Correa; the book includes two chapters on the cold fusion field and its researchers.

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Book Reviews

A Promenade Along Electrodynamics

by Junichiro Fukai
ISBN 0-971-4845-1-1
$21.95 Paperback, 240 pp.
Vales Lake Publishing, 2003

Review by Thomas Phipps, Jr.

The author of this admirable book is an Associate Professor of Physics who has taught at Auburn University since 1974. He earned his doctorate in plasma physics, did post-doctoral work at the University of Tennessee and Yale, and has had experience in industry. Thus he is well-prepared to offer to inquiring students what he calls a promenade through the tangled jungle of electrodynamics. This is not what you would expect—another gloss on Maxwell-Einstein theory. The woods are full of those and there is no need for another one. Rather, this book is something more interesting and useful to physicists and their science. It takes the less-traveled route through alternatives that history has crowded into the background, and shows that some of these supposedly discredited approaches—notably Weber's electrodynamics—in fact have much to offer for the future.

Anyone who takes a long view of the history of science must acquire an appreciation of the need for basic conceptual pluralism at all times. Pluralism at the level of *physics fundamentals* has become during the past century an endangered species, if not entirely extinct. Such an evolution can be dangerous: To allow any single mode of describing nature to become an orthodoxy that excludes all others is to compromise the long-term future of science by reducing available options. This happened before, for example, when the Ptolemaists identified the perfect *circle* as the only "philosophically correct" element by which to describe planetary motions. . .and the result (never more than a sort of spavined Fourier analysis) was a 1000-year blighting of progress in astronomy. Yet we seem condemned to repeat forever this dismal aspect of history. For in our day the perfect *field* has been identified as the philosophically correct element by which to describe nature, and the result is likely to be another 1000 years of misdirected effort.

If we pause for a moment to analyze where the field idea comes from and what it imposes upon nature, we must recognize that it is, at its foundation, an almost childishly primitive atavism. The concept of the field continuum appeals to and arises out of a deeply embedded notion of causality. . .the idea that nothing originating at point A can affect anything at point B except through a sequence of nudges effected by "contact actions" occurring within the space intervening between A and B. Stated baldly in that way, this notion is seen to acquire its obviousness through appeal to an extremely unsophisticated intuition engendered by direct experiences of the individual and the species, going back to the dawn of consciousness. Little more is involved than a universalization of our cradle experience that if we want something to move we must push on it. But more recent indirect experience, as with quantum processes, teaches us to treat with caution such intuitions conditioned by direct experience. Our minds are set up to fit us for survival in a macro world; they furnish no ready intuition of the micro world—which we are gradually coming to recognize as something else altogether. . .the "wave-particle dualism" being a case in point.

In the ideology that pervades today's physics, the field has been sent to do the job of (among other things) a physical "ether." Maxwell's intuition concerning a mechanical *luminiferous ether* of gears and idling wheels has thus given way to a clutter of vectors and tensors that nowadays fills "space." But even when buffered from the danger of direct confirmation or refutation through such a retreat into mathematical nirvana (or limbo), the field concept is beset by ingrained paradoxes. In order to lend substance to the mandate of causality (contact action), the field must have "parts" that push progressively on other parts, in order to describe the retarded "propagation" of the photon. But the field is by definition a mathematical continuum; and continua by definition do not possess parts. Or, rather, they possess only one part. . .in which case the distant action of a photon emitter upon its absorber must be instantaneous—that being what one (spatially extended) part means. (Page Zeno.) Nor does "quantizing" the field by fiat (postulate) give us a paradox-free description of "propagation." The problem resides in the field continuum itself: as a model of the physics it does not unambiguously support our primitive notions of causality. This is foreshadowed clearly in Maxwell's classical field theory: Two mathematically symmetrical classes of solution contend for the description of propagation—advanced and retarded. The above paradox (concerning the "parts" of the continuum) thus has a mathematical counterpart in the dilemma of choice between advanced and retarded solutions of the wave equation. This is currently solved expediently by ignoring the unwanted solutions. The modern physicist thus worships Mathematics as the great God over everything except his own desires. When the great God speaks out of turn He is ignored.

Perhaps, then, the underlying problem lies in our basic notion of causality. That seems to be what quantum mechanics is trying to tell us; namely, that nature includes in her bag of tricks something we currently label "non-local action," which is the antithesis of the Einsteinian point event. This subverts Einstein's famous insight as to the "relativity of simultaneity"—for it restores to distant simultaneity a meaning and relevance to physics. Certain things are happening at spatially separated points A and B that cannot be modeled by retarded (causal or progressive contact) action between those points. This elegantly dodges the advanced-retarded bifurcation that hallmarks field theory.

Now it happens that we collectively, as physicists, have been here before. It started with Newton's third law: A force originating at point A and acting at point B was balanced, in an *instantaneous* and totally acausal way, by an equal, opposite, and collinear reactive force from B to A. That remark-

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able perception has been trampled into the dust by the recent cavalcade of "relativistic" progress, based on the above-mentioned Einsteinian insight, and on the Lorentz force law of electromagnetism (which disobeys Newton's third law). But if the insight in question is overthrown by quantum non-locality, does this not leave us with many thoughts to rethink and insights to outsight?

Yes, we have been here before, and Weber's electrodynamics is one of the prime tokens of that earlier visitation. In the mid-1800's Wilhelm Weber devised the only truly and comprehensively "relativistic" analysis of electromagnetic phenomena ever proposed by a physicist. He expressed the force between two point charges as a function of their instantaneous separation (a purely relative coordinate) and of the time derivatives of that separation. There was no need to bring in frames of reference, inertial systems, or other innocent bystanders. In obvious ways Weber was ahead of his time; for instance, his theory was speculative in that it preceded the experimental discovery of point charges. But perhaps it was even more ahead of its time than that. Perhaps, like Newton's third law, Weber's electrodynamics anticipated (and made physical sense only in the context of) quantum non-locality. Both deal with "forces," which are not at all the same as radiation. The latter undeniably acts retardedly, but the inference from that fact to the hypothesis that *all* distant actions are retarded is an unwarranted imposition upon nature, seemingly refuted by the discovery of quantum non-locality. So, would it not have been nice if Weber's approach had been kept continuously and progressively alive by some small cadre of aberrant physicists (perhaps hidden in a cave somewhere, mercifully sheltered from the vicissitudes of academic fashion), so as to connect smoothly with the new quantum mechanics when it appeared in the 1930s? Instead of having to be practically rediscovered and awakened like the Sleeping Beauty near the end of the twentieth century by the kiss of investigators such as Assis and the present author, Fukai?

The effect of the latter's promenade is to throw into strong relief the past and future virtues of Weber's alternative approach to electrodynamics. Description in terms of Weber's relative coordinate forces us from the outset to accept the absoluteness of distant simultaneity. This is a giant step. . .backwards or forwards, depending on your scientific religion. (Its plausibility can be improved by recognizing that special relativity and its "relativity of simultaneity" depend crucially on Maxwell's specific version of electrodynamics—to question one being to undermine the other.) To most theorists this will seem a ridiculous turning back of the clock. But it is well to be reminded that Weber's electrodynamics was never refuted by empirical evidence, only by a shift of mathematical-descriptive fad or paradigm.

There was one aspect in which Maxwell's field theory seemed decisively superior—its prediction of electromagnetic wave propagation. But we have seen that "propagation" remains more than a little problematical, even in Maxwell's theory. And Fukai undertakes here to show, by reference to quantum mechanics, that radiation can, after all, be described by Weber-type theory. So, the age-old battle of discrete point particle vs. field continuum remains unresolved. It has been blown to a "final" settlement in our day-of-the-locust only by hurricane winds of fashion. If you think fashion settles matters of fact, you have passed the first essential test to qualify as a modern academic physicist. In the sacred name of homeland security, go read some other book! If you are young and trying harder, this one could endanger your chances of tenure.

In order to deal with radiation, Fukai points out that the vacuum can be modeled as a transmission line. [Others have noted this before—*cf.* R. I. Gray, "The Transmission-Line Vacuum," *Physics Essays*, 8, 285-298 (1995), an analysis that employs the Maxwell rather than the Weber viewpoint.] Considering their diametrically opposed premises, it is remarkable how closely the Maxwell and Weber versions of electrodynamics mimic each other predictively. However, it is not the similarities but the differences that are of greatest interest for physics. Hence Fukai appropriately devotes considerable attention to predictive differences subject to crucial experimentation. Some of the crucial differences have reportedly been tested already (*e.g.*, by Mikhailov), with results favorable to Weber. But such experiments need to be repeated. . .and will not be unless attention is paid to works such as Fukai's. Ironically, it is difficult to get projects funded that threaten accepted foundational paradigms—although for the fastest progress of science it should be just the other way. It seems to be human nature always to act as if we knew it all, in the hope that wishing will make it so. Such a hope is not only false but perniciously silly, in that it evokes the end of science and an unemployment problem for scientists.

Although I am in complete sympathy with this author in his insistence on pluralism in the analytic foundations of electrodynamics (a pitch that was made with consummate eloquence by Maxwell at the time he was getting his foot in the door—*cf.* his *Treatise*), I find it hard to believe that Fukai has said more than the first word about a Weber-type description of radiation. It would seem that to treat radiation fully it would be necessary to describe also radiation reaction. . .and the latter is generally thought to require third time derivatives (not present in either Weber's or Fukai's formulation). But it is also true that third time derivatives introduce spurious "run-away" solutions that seem to have nothing to do with physics. So, it is very early days to be making any hard-and-fast pronouncements. If you can pay the entry price of discarding the relativity security blanket (relativity of simultaneity), here is a delightful new-old area of electrodynamic research that seems full of boundless promise. To put your time into it is a gamble. . .but so is life. If you know conventional electrodynamics and are by nature a risk-taker, why not start with this little book?

Experimental Aetherometry, Volume 1

by Paulo N. Correa and Alexandra N. Correa
ISBN 0-9689060-0-1
$99.95 Paperback, 252 pp.
Akronos Publishing, 2003

Review by Eugene F. Mallove

The all-pervading aether (ether) is supposed to be "dead," so why a book in the twenty-first century about experimental measurements of that aether? Wasn't the Michelson-Morley experiment of 1887 the final denouement of the

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aether? Well, yes and no. Indeed, as this Correa and Correa husband and wife scientific team in Canada has stated, the null result of the Michelson-Morley experiment that led to the ascendancy of Special Relativity, indeed ruled out a static model of an *electromagnetic* aether—the so-called static "luminiferous" aether. However, an energetic aether with very real and measurable energetic properties was most surely *not* ruled out in 1887, and that is the fertile scientific ground on which this book stands.

When one pumps out a volume defined by a glass vessel, and has removed virtually all of the atomic and molecular species that previously flitted about in that space, what is left? Prior to my investigation of the work of the Correas, my answer would have been, "You have nothing." Remaining in the confines of the glass vessel would be a nearly perfect vacuum, *i.e.* pure nothingness, save for perhaps a spectrum of "electromagnetic radiation"—the fluctuation of tenuous, oscillating "fields" in that space. I might have spoken of omnipresent "zero point energy"— fluctuations of quantum energy that are said to exist down to an incredibly tiny subatomic dimension. Furthermore, I might have said that that "volume" within the glass vessel was not actually a "piece of empty space" but in truth a small section of "space-time," because the Einsteinian Relativity revolution had supposedly abolished any notion of space separate from time.

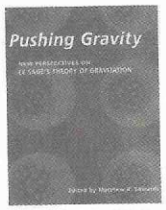
What attracts me most to the work of the Correas, as presented in this volume, is its firm grounding in some rather astonishing experimental measurements with heat, electricity, and light that they have made, which fly very much in the face of the expectations of conventional physics. This work was motivated by their knowledge and interest in the biophysics work of Wilhelm Reich (1897-1957), but also their need to get to the bottom of the excess electrical energy that they had observed since the 1980s in their PAGD™ reactors. I consider myself very fortunate to be among the relatively small group of observers who are familiar with the rigorous testing of their various working prototype technological devices, for which these basic experimental measurements evidently form a secure foundation. This makes the fundamental measurements of what they regard as a massfree aether all the more intriguing, even compelling. I can well understand the enormous conceptual hurdle that this presents to a conventional physics perspective, but careful examination of the Correa work will bring enormous rewards to those who persevere in their open-minded study.

My entrance to the field of New Energy came through the field of "cold fusion"/LENR. At one time I embraced the general notion, still dominant in that field, that it would eventually be possible to explain the excess heat and nuclear phenomena observed in LENR experiments without gross modifications of prevailing physics theories. But I have become convinced over the past fifteen years that we are in the midst of a Copernican-like revolution in scientific thinking. The vaunted models of twenty-first century atomic and nuclear structure, as well as the dogmas of Einsteinian relativities, quantum mechanics, and Second Law restrictions from classical Thermodynamics, are breaking down; there is a very serious impasse that has been brought about by experimental findings in the new energy field. None of the theoretical constructs put forth by others in either LENR or the related field of "hydrino physics" pioneered by Dr. Randell Mills has proved universally satisfactory as a covering theory. On the other hand, I have some hope that Aetherometry may ultimately be applied to explain these forms of new-energy, as well as the experimental findings of the Graneau and Graneau *et al.* teams and several other groups. We shall see. This is not a new dogma to replace the old, rather a fresh look that is open to criticism and alteration.

Yes, the Correas also have a body of theoretical development linking all of their experimental work together, their Aetherometric Theory of Synchronicity (or AToS, for short). This has not yet been published, in full, and that will cause some difficulty. The reader will find expressions from AToS used from time to time in this book to characterize the experimental results, but that should not prevent a general understanding of the great significance of the experiments by themselves. One will, however, begin to see how these experimental results can be gathered under the umbrella of a coherent theory— the AToS—whether or not that theory is correct in this or that particular. A theory is useful only insofar as it can make useful predictions, as well as postdictions, and AToS has apparently been successful in both these ways.

There has been much misinformation circulating in recent years about the work of the Correas, which *Infinite Energy* began covering in 1996 in Issue #7. They, and the self-funded companies or institutes they have founded—Labofex, Akronos, and ABRI (Aurora Biophysical Research Institute), have been for some time located in the Toronto, Canada area. Their work has been published in *Infinite Energy*, in very limited part since 1996, but its most extensive and comprehensive form can be found on the Aetherometry website at www.aetherometry.com (where this text can also be purchased). This volume encompasses the first seven downloadable monographs, which deal primarily with thermal anomalies and electroscopic anomalies associated with Faraday cages and Reich's "orgone accumulators" (ORACS).

One of the great benefits of owning this bound volume is the authors' Introduction, in which they give one of the most crisp and well-motivated accounts of their work. I'd like to see more such technical synopses by the Correas—perhaps even a book that would serve as a kind of "layman's guide" to Aetherometry. For those of us who are serious about finding a valid and consistent restructuring of the foundations of modern physics, this would be a great help. On the other hand, one should not shrink from the difficult but always rewarding task of getting down to the nitty gritty of experiments and the consolidation of new results. Whatever the flaws in experiment or interpretation that may lurk here, this historic log-book of several lifetimes of work is a must read for those who would like to see the world of science in an entirely new light. ❑❑❑



Paperback, 2002
316 pp.

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Commentary and Experiment on Electric Fields and "Free Energy"

Philip Stone*

Editor's Note: This thought-provoking contribution by Philip Stone is in response to Durwood Creed's "Hollow Conductors vs. Zero-Point Energy" (IE #45) and the response to that article by Richard Hull, "Perspective on the Hollow Conductor Paper by Durwood Creed" (IE #45).—EFM

Any physics textbook will tell you that the force due to the electric field between two charged objects would be 81 times as strong in air than if the same identical objects were submerged in water. Here is a long distance force of nature, as basic to the Universe as gravity, very easily interfered with. To me, it is the same as if the gravity between objects depended on the medium surrounding them.

A good physics text will discuss the complete blocking of the electric field by the positioning of metal or metal screening around the object. If such a method existed for gravity, people would be tremendously impressed. Why is it that no one is even slightly impressed by the ability of metal to block the only other long distance force in our Universe?

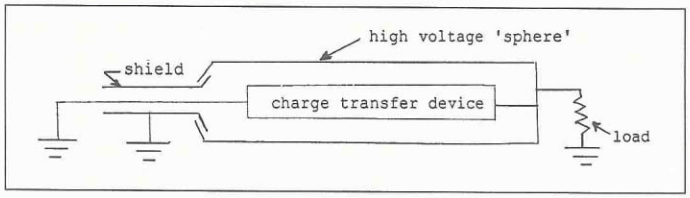
Again, from any textbook we learn that an object charged to any minuscule voltage (with respect to ground) will give all of its extra charges to another object charged to a stupendous voltage (with respect to ground). Internal contact is all that is required. This is the famous Faraday "ice pail" experiment. A really good text will discuss the fact that the external charges will have no effect whatsoever on the inside charges and vice versa. Granted, the low voltage object is repelled by the high voltage object when the objects are outside of each other. At high enough voltages, it might even become impossible to force the low voltage object closer to the high voltage object. Note that it is not repelled at all once the object lies within the confines of the high voltage object. In fact, an opposite charge suddenly appears on the inside of the outside object's surface and the inside object is then attracted to the outside object. This is the principle behind the friendly Van de Graff generator.

To go any further, one must understand the operation of a Van de Graff generator. Briefly, a Van de Graff generator consists of a large hollow metal sphere supported on a nonconducting pipe. Inside the pipe is a conveyor belt of nonconducting material upon which charges are placed either by contact with dissimilar materials or by ion spray. By moving the belt, the charges are brought into the inside of the hollow metal sphere. Once inside, every charge induces its opposite to appear on the inside surface of the sphere. This forces a charge identical to the one on the belt to appear on the outside. A sharply pointed pickup device is then used to bring the belt charge together with the induced charge, the air ionizes between them, and they neutralize each other. This leaves the charge identical to that which had been on the belt on the outside of the sphere. The charges on the belt are strongly repelled by the high voltage sphere as they approach the sphere, resulting in drag on the belt and therefore the required energy usage to satisfy the Conservation of Energy Law. This last sentence is important—remember it!

Further, it must be understood that a Van de Graff sphere may be connected by a given resistance to its base or to ground. The potential on the sphere will rise to a voltage consistent with the current on the belt according to V = IR (Ohm's Law). Conventionally, on a small Van de Graff, the voltage rises without limit until the air breaks down and discharges the sphere.

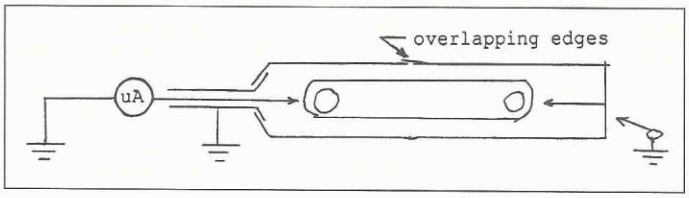
Now we have to enter the realm of "field free" regions of space. The inside of any charged metal object, free of other separate internal charged objects, is a "field free" zone. All fields present within the inside of any given sphere are the result of any present separate internal charges, and their induced opposites. The separate internal charges interact in no way whatsoever with any of the external charges that may be on the outside of the Van de Graff sphere. Likewise, the inside of a long tube made of metal is field free (fringe zones may exist near the ends). What I wished to explore was whether the field free region of the inside of a Van de Graff type sphere could be connected to the field free zone inside of a metal tube leading from some distance away to the inside of the sphere. I was assured by "reliable authority" that this connection could not be made. The inside of the sphere was at a different voltage than the tube and therefore the two field free regions were not the same. Not trusting authority, I devised my own experiment to find out for myself.

Conceptually:



The charge transfer device would ideally be a high current, low voltage electron gun. In my case I had to use a contact electricity device (the belt and pulley mechanism from a Van de Graff generator—without the sphere). The charge transfer device chosen must be able to maintain the "separateness" of the high voltage sphere, as the belt and pulley set-up does in the Van de Graff generator.

My experiment:



Initially, current in my experiment would flow, just as predicted by "authority," only when the "sphere" was grounded. I had used the box the Van de Graff came in, wrapped in aluminum foil, as my sphere. Incorrect overlap-

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ping aluminum foil was to blame—the edges were not taped down sufficiently and the external electric field was able to "leak" into the interior and prevent the charges on the wire (or the belt) from approaching the inside of the sphere. This accidental intermediate step occurred because I only taped a small piece of the edges on the long sides of my "sphere" down. Interestingly, it proved that the belt and pulley set-up by itself would not generate the voltage to create a Van de Graff arrangement. It also proved that there exists a rejection mechanism to prevent the flow of charges within the system, at least if things are not properly done. Serendipity strikes again.

On the next run, with the edges of the foil properly taped down along every edge of the foil to create a real field free region, charge flowed to the "sphere" regardless of whether the sphere was grounded or not. What did this prove?

I believe that it has been shown that the field free zone of the metal tube—at no voltage with respect to ground—is the same as the field free region of the Van de Graff sphere, at high potential. According to "authority," I should have had to apply a voltage equivalent to that on the sphere to enable the charges to approach the sphere from anywhere outside. By using the field free tube, I was able to circumvent the conservative electric field that exists around the sphere. I believe we are forced by this experimental evidence to say that "when conservative fields are circumvented by shielded pathways, the First Law of Thermodynamics does not necessarily hold." You can get something for nothing.

Where should we go from here: First, duplicate the experiment. What has become supremely apparent from cold fusion is that what one individual discovers by experimentation means nothing to the rest of the world. Fortunately, my experiment is easy to duplicate. I can not promise that any certain amount of overlap of the aluminum foil, taped down in whatever haphazard manner, will give you any particular amount of "leakage" of the field for the charge rejection part of the experiment. The second part of the experiment, where charge always flows, is the important part of the experiment anyway. Second, change milliwatts of anomaly to kilowatts of power.

As stated before, the ideal is an electron gun with hundreds of milliamp capability. The discharge of the sphere to the shield will also have to be addressed. There are some Van de Graffs that rest on columns of alternating rings of conductor and insulators, all connected right down through with resistors to divide the voltage in steps from the sphere to the ground. For the higher voltages desired to get to kilowatts, the same thing must be done for the shielded pathway to the inside of the sphere. With a manageable voltage jump between the sphere and the shield, and then between each layer of shield, very high voltages can be achieved. Even the small Van de Graff, like the one that I used, will routinely reach 100,000 to 200,000 volts and this is certainly enough voltage to test this theory thoroughly. After all, 500 milliamps times 100,000 volts yields 50 kilowatts—enough to convince any skeptic. Consumption by the electron gun shouldn't top even 2,000 watts (perhaps .5 amps times 1,000 volts plus 50 watts heating element plus 50 watts low voltage first focusing stage).

Useful power merely involves going to AC. The shielding ability of metal against a changing electric field is a matter of thickness. Actually, 60 Hertz is, for all intents and purposes, DC (almost any thickness of metal will do). Vary the voltage at 60 Hertz (by varying the current sent to the sphere), connect the "sphere" to a very high voltage transformer and very useful amounts of energy, from very compact sources, would be the result.

Overt shielding is not even really necessary to demonstrate the principle. This could be done: Construct an electron gun along the lines of a TV tube, say 50 mA and 25,000 volts. Use the gun to fire electrons at a Faraday cup at, let's say, 20,000 volts. Output at the cup would be 50 mA times 20,000 volts equal to 2,000 watts. Proper construction would keep the leakage current at the anode to 10% or say 5 mA. So: 5 mA time 25 killovolts equals 125 watts. Heater use would be 10 watts or less, first stage accelerator would be 10 watts or less. For 145 watts input, a regular electron gun might deliver 2,000 watts. If you care to, apply this principle to make the "charge transfer device" of any desired system you wish to build.

The reason why a regular TV tube doesn't violate the Law is because the aquadag (the conductive coating on the inside of the sides of the TV tube) and the mask (which didn't exist in earlier tubes) are maintained at the same high voltage as the accelerating anode. These parts of the tube are efficient at scavenging any loose electrons flying around the inside of the tube (to prevent scattering of the beam), but connecting first to the aquadag is mainly done to avoid a problem that was experienced with very early tubes.

Early tubes had a separate connection for the aquadag and the anode. If the aquadag connection was broken, or left open, the electrons would eventually find themselves on the aquadag (by mutual repulsion inside the vacuum tube) and the voltage on the aquadag, which would act very much like a Van de Graff generator, would reach high enough levels to discharge to the chassis ground, perhaps through the air or through the technician working on the unit. I ran across a warning for this in a very, very old vacuum tube manual.

The "principle of shielding" can even be applied to the acceleration of particles, resulting in a DC linear accelerator. I feel that I have proven that the field free region of a metal tube can connect to other field free regions. In this case, the parts that do the accelerating are themselves also tubes, lined up at alternating voltages. At the center of each accelerator tube, away from the fringe effects (which can even be eliminated by using screening at the ends of the accelerator tubes), you can start a shielding tube to carry the particles through the area where the electric field is in the "wrong" direction. The accelerator tube would experience the usual reverse voltage applied by the accelerating particles to the accelerating tubes. Maintaining a DC voltage is far easier than the current system of high voltage, high frequency sources. If the DC source used is reversible, then even the reverse voltage is only temporary. At any rate, multiple accelerations of the applied voltage can be had for the current caused by the leakage due to the interception of scattered particles. Also, the DC output may have its own advantages. Note that in the vacuum of the accelerating chamber, moderately high voltages can be maintained between accelerat-

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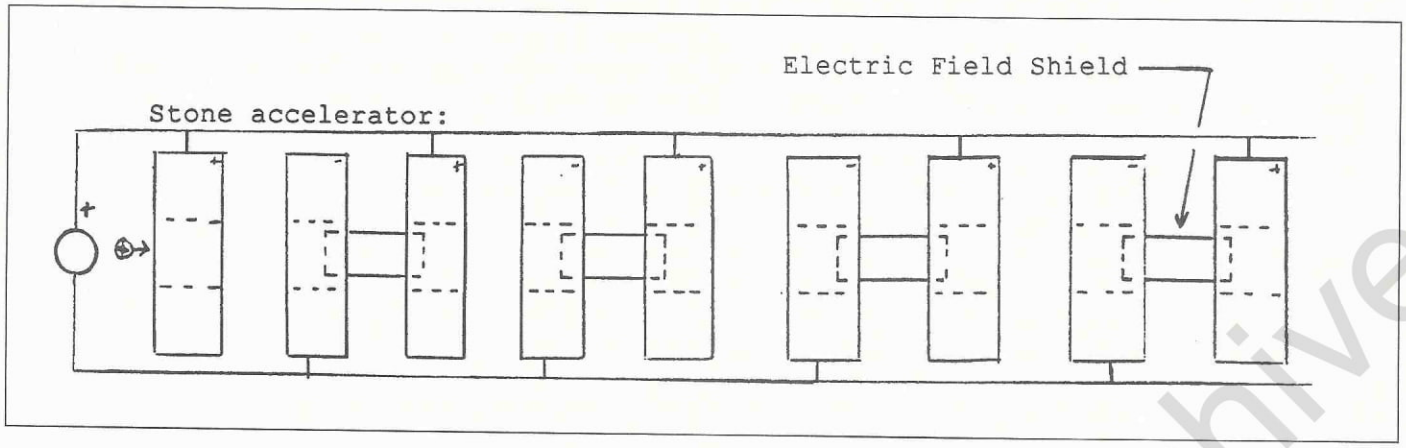

ing tubes and the shield tubes with very little leakage current between them.

When you realize that the main energy consumption of a regular Van de Graff generator is that of the energy used to force the charges toward the sphere as they ride externally upwards on the belt (the unshielded case), then the conclusion that I have drawn becomes almost obvious. When you interfere with the force between the outside of the sphere and the approaching charges, then you get something interesting.

Theoretically, you could immerse a Van de Graff in pure water up to the middle of the sphere and reduce the consumption from the charges being repelled by a factor of 81. This would short out the sphere and could not be done in reality. Covering the bottom of the Van de Graff with an appropriate dielectric material should also reduce the forces against the approaching charges. Exactly how much depends on the material and the geometry. Even something as simple as using a plastic pipe full of water with the wire in the middle used to bring the charges up to the inside of the sphere would create the conditions necessary to begin to violate the Law. Any reduction of the repelling force and you would begin to violate the Law. Metal shielding is, of course, the best. In my experiment I placed the entire apparatus inside a known "field free" volume of space to be sure of what I was measuring and observing. The dielectric reduction of force principle can be applied to the shielding tubes of the particle accelerator concept as well.

Remember that the charges on the outside of the Van de Graff do not interact at all with any charges on the inside. Remember that inducing the opposite charges that appear on the inside surface does not depend on the voltage on the outside. Remember that the inside charges are attracted to the induced charges, which re-releases the energy used to create them in the first place (when they are finally brought together).

I remember a director of particle research lamenting that his 2 million volt Van de Graff ". . .took kilowatts to run. How could you expect to get energy from it?" It had better take those kilowatts to run. Two million volts times the 20 milliamps carried equals 40 kilowatts. If it didn't take at least 40 kilowatts to run it, then it would violate the Law already. Note that the spraying of 20 milliamps at 5,000 volts onto the belt only consumes 100 watts. The energy consumption is in the large motor necessary to force the highly repelled belt toward the sphere.

If I have proven that the external field on a Van de Graff sphere can be circumvented by using shielded means, then I have proven an exception to the First Law of Thermodynamics. What could be more fundamental than that? Either I observed current flow or I did not. Either I placed the belt and pulleys in a known "field free" region or I did not. Either you can affect the force between electrically charged objects or you can not. Either "field free" regions can be connected together or they can not.

Why should anything like this be possible?

The reason that what I have described is possible is entirely because of the real nature of the electric field. It starts on metal surfaces (in these cases—I refer not to "space charge" cases) and it ends on metal surfaces. It does not continue on through the metal and out the other side. It ends. Compare it to gravity. If gravity ended on a surface, or even if it was completely balanced out inside volumes of space defined by certain surfaces, then it too could be used to violate the First Law. To circumvent conservative fields by shielded means is the first part that is necessary.

What appears to matter most of all is the "ice pail" phenomena. Because the inside surface of the sphere acts like it is at the opposite voltage to the charges brought in, the charges can move from the "field free" region to the high voltage surface. If it could not, then none of this would be possible. Without the "ice pail" phenomena it might be possible to join the "field free" regions, but then you couldn't get to the high voltage side without using large amounts of energy. You need to get "charges" to where they can do some good. Despite what it says in all the books, the inside surface does not "act" like it is at the voltage displayed on the outside. This is what makes the preceding concept work. This is why.

About the Author

Mr. Stone received an associate's degree in engineering science from Mohawk Valley Community College in 1981. He also attended the Rochester Institute of Technology. He has designed and built from scratch: a 50 mpg car (with Honda components); a superinsulated home; and a 34 foot catamaran houseboat (finished in 1998; taken from Utica, New York to Tampa, Florida in 1998-1999 and from Tampa to Utica in 2001, solo on a single 9.9 HP engine at 8 mpg).

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A Conversation with James P. Hogan

Tim Ventura*

Author James P. Hogan has written a number of science fiction novels, but the one that most captivated me was the 1977 classic *Inherit the Stars*. The novel begins with the discovery of a 50,000 year old man's body on the moon; the subsequent investigation into this unprecedented event leads to world-changing revelations about man's place in the cosmos. Although the book was framed as a piece of fiction, it raises several excellent questions about science, and how subtle pieces of scientific evidence can shape and reshape what we believe to be fundamental truths. For example, in the book the belief that man evolved on Earth is irrevocably shattered by the investigation into the frozen body—named "Charlie" by the investigators. Despite the many pieces of supporting evidence that lead us to believe that we originated here on Earth, the fictional discovery reshapes that evidence into a larger hypothesis that includes the new evidence.

I called James P. Hogan on a Friday morning, while he was in the U.S. on business. He was in a hotel room in Florida, and I was lucky to catch him just as he was about to return to his residence in Ireland on Monday; he was on a tight schedule. Needless to say, I was grateful for any time that he could give me to discuss science and technology. Our brief conversation ended up being a one and a half-hour discussion on a wide variety of topics from particle physics and antigravity research to artificial intelligence.

One of the first things that he mentioned was e-mail. "You know," he said, "for those of us on dial-up, it would be easier if you sent out a link to attachments rather than two-megabyte files embedded in email." I quickly apologized for this—I use a broadband connection and often forget to check some of the file sizes that I attach. I suppose that there might be a small ego component also—after all, in light of the Lifter experiments I tend to consider my garage to be an immensely interesting place, and often get overzealous in sending out my garage-experiment video clips on the Internet.

I told James that I was calling to talk primarily about antigravity and field-effect propulsion, and described in brief the experiments that I've participated in with the open-source Lifter technology. "Can you tell me what's actually going on with it?" he asked. I replied that while I believe that there definitely is an ion-wind component (at least in the lifters I build), I felt that the Biefeld-Brown Effect was something unique, and not merely a corollary to ion-wind. Hogan's concern stemmed from the branding of the Lifters as being "antigravity" devices, which he felt should be reserved for unique methods of propulsion. "While ion wind may not be understood by the majority of people," he said, "it does fall within the confines of conventional and understood physics." This response makes a lot of sense; after all, one of the criticisms of the Lifter technology has been that if it can be explained using conventional physics then it shouldn't be associated with antigravity and other revolutionary technological concepts. In reply, I explained to him the evolution of the American Antigravity website, and of the research and experimentation that I've been involved with. In addition to the Lifter technology, which I believe contains a field-effect propulsion component, the American Antigravity website covers a wide range of associated technologies that come from a similar background of anomalous physics.

"It really was unavoidable," I told him. "Once I started getting results with the Lifters and began posting my clips online, I started to get deluged with antigravity ideas and experimentation from other experimenters across the globe. From what I understand, Jean-Louis Naudin in France also receives a diverse array of ideas relating to the experiments he posts online. I've been really surprised at how many people are out there experimenting with these concepts. These experiments are really the manifestation of people's vision and dreams, and I've been privileged to be able to describe twenty or thirty different unique propulsion concepts on the website. In that regard, the term "antigravity" at least describes the focus of the website, which is really about unique propulsion concepts that counteract the force of gravity. Many of them have not been explained sufficiently by conventional theory to qualify as anything except antigravity, at least for the time being."

Hogan briefly described for me his interest in the work of Dr. Andre Assis, a Professor of Physics at the University of Campinas in Brazil, and also suggested that perhaps physics had lost something when it settled on the work of Maxwell to describe electromagnetism instead of keeping the door open to consider other theories that might have allowed interactions with gravitational force. "If it turns out that gravity is a byproduct of electrical force," Hogan said, "then by manipulating enormous amounts of electricity we may be able to reproduce these effects." This is an idea that I've heard in a number of different forms—that perhaps gravitation is a "shadow force" that's the result of an as-yet undetermined electromagnetic interaction.

I asked James if he subscribed to Vernor Vinge's hypothesis of the singularity, and he responded that he was skeptical of the notion based on super intelligent AI in the near future because of the approach that's been taken in developing AI systems. "If you visualize the many worlds hypothesis in physics, then perhaps consciousness is really about being able to visualize one of the many outcomes of a choice and then making the choice to achieve the outcome. It's based on a value scale, and computers don't have those values. When a house-builder is stacking bricks to build a new home, how does he know that the home will exist when he's finished? Aristotle touched on that when he said essentially that it's because the home already existed in the man's vision of the future."

"In this case the many worlds hypothesis is interpreted to mean that an entirely new world is created each time a

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choice is made, but I think that it's tough to make a case for that. You get in the car to travel to Chicago or New York—if you choose Chicago, it doesn't mean that New York doesn't exist, it just means that the probability-wave has collapsed and put Chicago in your timeline."

I mentioned to Hogan that from my limited knowledge of psychology I've always felt that it would be impossible to create a true artificial intelligence without the intelligence having emotions. In my example to him, I mentioned that every morning when I wake up, I feel a bit different—I could be cheerful, tired, irritable, or sick perhaps—but see the same objects in the room around me. This gives me a collection of perceptions about the world around me that have been gathered in different frames of mind, and in different emotional states. Therefore, I may see the alarm clock with indifference one morning, and I may hate it the next—a computer can't apply perceptions from a variety of emotional states to the world because it only has one emotional frame of reference. James responded, "I would agree that emotions will be seen as much more important in AI development in the future. I think that the Victorian elevation of pure intellect is reaching its limit. Intellect alone has value to be sure—it's good for what it's good for—but emotional states provide us with a perspective."

"In the 1970's a lot of researchers did experimentation with programming languages to try and develop AI and allow computers to not only recognize, but also to understand speech. They tried a wide variety of approaches to parsing language, but ultimately failed. I believe that this is because computers interpret language to convey only strict meaning, whereas humans use language only to convey meaning that isn't already obvious."

"When I say a word, that word really has no meaning in the real sense. However, I may see a flash of an image in my mind that allows to me associate a variety of different meanings with the word. Hence, when I say that word to you, I can be assured that you will also see a similar flash, and a similar collection of meanings. A computer can't see that because it doesn't have the life-experience to draw from. Computers don't exist in the real world—they're programmed with only the information that is put into them. People are different, primarily because people create their own meaning."

James described in detail his concerns about the scientific establishment, and his worry that by its greater and greater association with government funding in the post World War II era that science has become more and more intolerant of the new ideas that spark innovation. "I worry that science has become something like an intolerant religion. You know, the six or seven years that students spend in school serves to deeply ingrain in them a disregard for ideas outside the conventional norms. Science has its own social groups, and its own system of rewards—what scientists end up fearing more than anything else is being ostracized by the scientific community, which keeps them from pursuing many fundamentally new areas of research. I have several acquaintances that have been ostracized to some degree or other by the scientific establishment for holding ideas that were taboo in physics. These people aren't necessarily quacks—in fact some of them have true genius—the problem is that they're going against the grain."

I suggested that perhaps this led to "incrementalism" in science, where new breakthroughs get smaller and smaller as time goes on, rather than true breakthroughs revolutionizing our concept of the universe. "Exactly!" he said. "Starships to travel to distant star systems aren't in the quarterly budget."

Hogan discussed the Michelson-Morley experiment, in which laser-interferometry is used to determine the speed of light, and how that relates to how we measure constants. "You know," he began, "the original concept of the ether came out of a very mechanistic world view—it was believed to be a fluid of some sort. But perhaps the reality is that if an 'ether' of sorts does exist then it's more of a local field effect. For instance, as we do our measuring for constants like the speed of light on the Earth, perhaps the Earth's local field-effect dominates our results. . .maybe those results would be different outside the sphere of influence of the Earth's local field-effect."

"If you look at the Earth's magnetosphere in space, it's maybe twenty times the size of the Earth. If you could see it from a side-profile, you'd see a large bubble, shaped like a tear-drop from buffeting by the solar wind, and somewhere near the front of that tear-drop is a tiny dot, which is the Earth itself. All of the measurements that we do have been inside of the magnetosphere and perhaps this local field-effect fundamentally change some of those properties once you get outside of it. It's like being in the cabin of a plane, and trying to measure the speed of the wind outside from the interior. It would appear to anyone in the cabin that the air isn't moving at all. You can even talk to the person sitting next to you—but now try sitting out on one of the wings and talking to that person. It's a much different story."

Hogan suggested that it would be interesting to conduct experiments like the Michelson-Morley experiment outside of the Earth's sphere of influence to see if the results were any different. "Once you get outside of the magnetosphere, then you're still in the local field effect for the sun, due to the solar wind. If you go farther out and leave the solar system, you're still being affected by cumulative fields and radiation from a variety of sources, such as other nearby solar systems. The background of space is like a sea—it's choppy and rough, but the patterns on the surface are different because there are different effects causing them. Let's see how that affects our presumptions about these universal constants."

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The Possibility of Strong Coupling Between Electricity and Gravitation

Takaaki Musha*

Editor's Note: The paper is noteworthy, apart from its theoretical proposal, in revealing experimental work conducted at the Honda Corporation Research Institute in 1996.—EFM

Abstract
The finding of Prof. Biefeld and T.T. Brown, which is called the Biefeld-Brown effect, suggests strong coupling between electricity and gravitation. However, this phenomenon can not be predicted within the framework of conventional physics. The author attempts to explain this phenomenon by introducing an asymmetrical gravitational field generated inside the atom by a high potential electric field; he also verifies the theoretical value compared with the experimental result.

Introduction
Prof. Biefeld and T.T. Brown discovered that a high potential charged capacitor with dielectrics exhibited unidirectional thrust toward the positive plate when the atoms of a material are placed within the electric field of a capacitor. This phenomenon is called the Biefeld-Brown effect (B-B effect) and it suggests a connection between electricity and gravitation.

Characteristics of the B-B effect can be summarized shown as follows:[1]

1) The separation of the plates of the condenser—closer plates, greater effect.
2) The higher the specific inductive capacity of the dielectrics between the plates, the greater the effect.
3) The greater the area of the condenser plates, the greater the effect.
4) The greater the voltage difference between the plates, the greater the effect.
5) The greater the mass of the material between the plates, the greater the effect.

However, the coupling between electrostatic and gravitational fields can be predicted neither by General Relativity, nor conventional field theory. The author attempts to explain this phenomenon by introducing a new gravitational field generated inside the atom by a high potential electric field.

Theoretical Consideration on the B-B Effect
Weak field approximation of Einstein's General Relativity leads to the generalized formula of Lorentz force given by[2]

$$F = q(E + v \times B) + m(E_g + v \times B_g), \tag{1}$$

where q is the charge of the particle, m is the mass of the particle, E is the electric field, B is the magnetic field, v is the velocity of the particle, E_g is the electrogravitic field, and B_g is the magnetogravitic field.

From which, gravitoelectric-electric coupling inside the static atom under high electric potential field becomes

$$qE + mE_g = 0, \tag{2}$$

by assuming that the internal volume of an elementary particle is a region of force-free field like a superconductor.[3] Then the gravitational field generated at the center of the charged particle by an external electric field becomes

$$E_g = -(q/m)E. \tag{3}$$

Comparing q/m values of an electron and a pion, E_g can be generated by an electron rather than a pion, hence we can let $q \approx e$ and $m \approx m_e$, where e is a charge of an electron and m_e is its mass. For the estimation of gravitational effect, we introduce the following approximation of the electrogravitic potential given by

$$\Phi_g = -(e/m_e)E\{\delta^2 x/(\delta^2 + x^2)\}, \tag{4}$$

which satisfies the following conditions:

$$\partial \Phi_g (0) / \partial x = -(e/m_e)E, \tag{5.1}$$

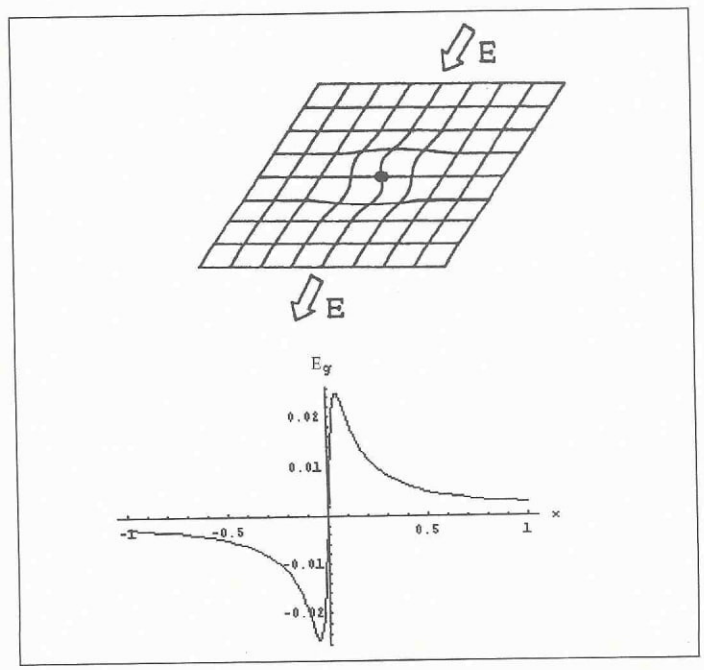

Figure 1. New gravitational field generated by an external electric field.

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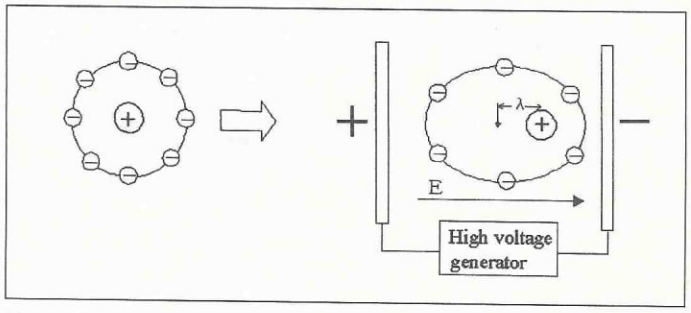

Figure 2. Deformation of the atom in an external electric field.

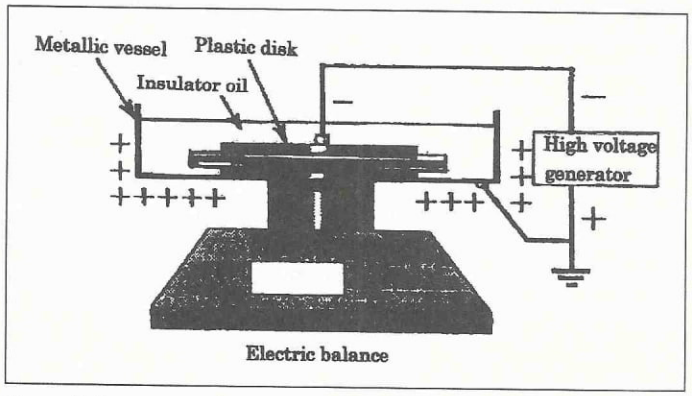

Figure 3. Experimental set-up.

$$\partial \Phi_g (\pm\infty) / \partial x = 0, \qquad (5.2)$$

where δ is a length of the domain at which the new gravitational field is generated.

Figure 1 shows the deformation of the space generated at the center of the elementary particle and the shape of the electrogravitic potential. By the asymmetric electron orbit shown in Figure 2 generated by the external electric field, the electrogravitic potential at the center of the atomic nucleus becomes

$$\Phi_g = \Phi_g (r + \lambda) + \Phi_g (r - \lambda), \qquad (6)$$

where λ is a displacement of charge by an applied electric field and r is an orbital radius of the electron around the nucleus.

From which, the electrogravitic force generated by electrons circulating around the nucleus, the number of them equals the atomic number Z, is given by[4,5]

$$E_g = \partial\Phi_g / \partial x = \delta^2 eE / m_e \sum_{i=1}^{Z} [(r_i + \lambda)^{-2} + (r_i - \lambda)^{-2}] \ , \qquad (7)$$

when satisfying $|r_i \pm \lambda| >> \delta$, where r_i is the orbital radius of each electron around the atomic nucleus. For simplifying the problem, we set $r_i \approx r_0$, then Equation 7 becomes

$$E_g \approx Z\delta^2 eE/m_e[(r_0 + \lambda)^{-2} + (r_0 - \lambda)^{-2}]. \qquad (8)$$

For relative lower voltage, we can suppose that $r_0 >> \lambda$. Then Equation 8 can be approximated as

$$E_g \approx -2\delta^2 Ze/(m_e r_0^2) \{1 + 3\lambda^2 / r_0^2 + ...\}E. \qquad (9)$$

If we suppose that additional equivalent mass in a space due to the electric field[6] is canceled by negative mass created by the new gravitational field, we have the following formula given by

$$\int_V 2\pi G\varepsilon E^2 / c^2 dv - \int_V E_g^2 /(2c^2) dv = 0 \ , \qquad (10)$$

where ε is permittivity, G is a gravitational constant, and c is a light speed. From which, we have

$$\delta \approx \sqrt[4]{\pi\varepsilon G m_e^2 r_0^4 / e^2} \ . \qquad (11)$$

If r_0 is replaced by Bohr's radius and ε equals ε_0, which is the permittivity of free space, we obtain the length of a domain where the new gravitational field is generated to be $\delta \approx 8.3 \times 10^{-22}$ (m), that is much smaller than the radius of the electron, which is about 2.8×10^{-15} (m). Then acceleration of the dielectric material induced by high potential electric field can be approximated from Equations 9 and 11 as

$$E_g \approx -Z\sqrt{4\pi\varepsilon_r\varepsilon_0 G} \cdot E = -8.62 \times 10^{-11} Z\sqrt{\varepsilon_r} \cdot E, \qquad (12)$$

where ε_r is the specific inductive capacity of the dielectric material determined as $\varepsilon = \varepsilon_r\varepsilon_0$. From which, the force generated by high potential electric field becomes

$$F \approx 8.62 \times 10^{-11} Z\mu S\sqrt{\varepsilon_r} \cdot V / t, \qquad (13)$$

where μ is a total mass of the dielectric material per unit area, S is an area of the capacitor, t is a thickness of the capacitor, and V is an impressed voltage.

This equation presented here satisfies characteristics 1 through 5 mentioned in the previous section and it also predicts another characteristic for the B-B effect shown as follows: The greater the atomic number of the material between the plates, the greater the effect.

Experimental Results

From February 1 until March 1, 1996, a research group at the Honda R&D Institute in Japan conducted experiments to verify the B-B effect with an improved experimental device[7,8] to reject the influence of corona discharges and electric wind around the capacitor. For the rejection of these effects, the capacitor was set in the insulator oil contained within a metallic vessel, as shown in Figure 3. The capacitor used at the experiment (Figure 4) was a circular plate made of glass with thickness=1mm, diameter=170mm and weight=62g. The specific inductive capacity of the capacitor was about 10. They conducted experiments for both cases, +DC 18kv and -DC 18kv applied to the capacitor. The experimental results obtained by the Honda research group are shown in Figure 5, where the horizontal line is for the number of the experiment which they conducted and the vertical line is for the weight loss of the capacitor.

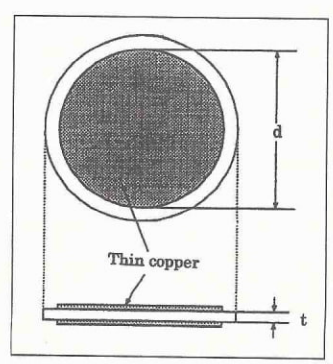

Figure 4. Capacitor used for the experiment.

Analysis of the Experimental Results

By the experiment results, the coefficient κ as follows can be

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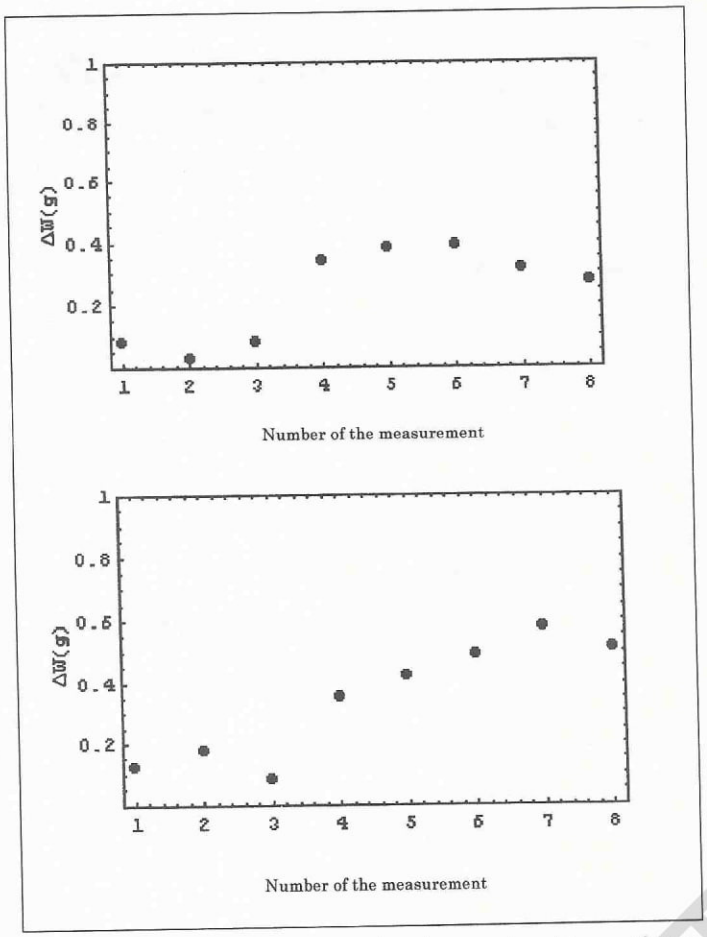

Figure 5. Weight reduction observed at the experiment (upper figure: +18kV, lower figure: -18kV).

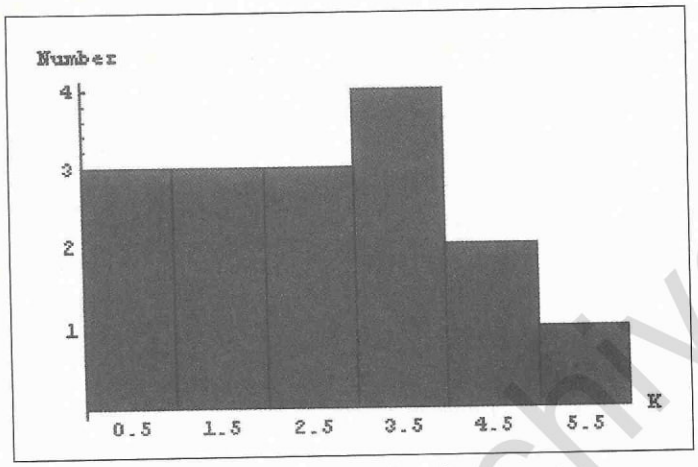

Figure 6. Histogram of the experimental results.

Propulsion System	Thrust(N)
Jet engine	2×10^5
Chemical fuel rocket	2.45×10^5
Arc-jet	1.50×10^{-1}
Nuclear power	8.82×10^5
Photon rocket	3.3
B-B effect*	100

Table 1. Thrust of the propulsion systems and the B-B effect. *Calculated for mass=100Kg, diameter/height ratio=100, ε_r = 5, and E = 7 x 10^8V/m [Reference 9].

determined by

$$\kappa = E_g/E = (\Delta W/W)(t/V)g_0, \qquad (14)$$

where ΔW is a weight loss of the capacitor under high potential electric field, W is a weight of the capacitor, and g_0 is the gravitational acceleration at the Earth's surface.

From which, histograms of the experiment were obtained, as shown in Figure 7, where the horizontal line shows the value K, which equals κ times 10^9, and the vertical line shows the number of observed results. Statistical analysis shows that the mean value of K obtained is 2.59 and its standard deviation is 1.46, then we have $\kappa = (2.59 \pm 1.46) \times 10^{-9}$.

From Equation 12, the absolute value of κ can be given by

$$|\kappa| = 8.62\times10^{-11} Z\sqrt{\varepsilon_r} \quad . \qquad (15)$$

Most of the ingredient of glass is S_iO_2, the mean value of Z per unit atom can be roughly estimated as $Z \approx (14 + 8 \times 2)/3 = 10$, so we have $|\kappa| \approx 2.73 \times 10^{-9}$.

From which, we have

$$(E_g)_{measured}/(E_g)_{theoretical} = 0.95 \pm 0.53. \qquad (16)$$

Thus it is considered that the force generated due to the external electric field can be a new gravitational field generated in the micro level by strong coupling between electromagnetism and gravitation. By using the equation which the author derived, Iwanaga analyzed the effectiveness of the B-B effect as a propulsion system in his paper[9] and he estimated the thrust obtained by the B-B effect is much better than that of an arc-jet propulsion system, as shown in Table 1. He considered it would be profitable to apply this propulsion method to small space vehicles.

Conclusion

The theoretical equation for the B-B effect, which satisfies the characteristics clarified by T.T. Brown, is derived. Because the experimental results agree well with the theoretical calculation, it is considered that the force generated due to the external electric field is due to a new gravitational field generated at the micro level induced by strong coupling between electromagnetism and gravitation.

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About the Author

Dr. Musha received the M.E. (1977) and Ph.D. (1994) from Shinsu University (Nagano, Japan), both in bio-science and mechanical engineering. He joined the Advanced Space Propulsion Investigation Committee (ASPIC) in 1994, which was organized under the Japan Society for Aeronautical and Space Sciences and whose purpose was to study all kinds of non-chemical space propulsion systems. Dr. Musha's research interests include physics of superluminal phenomena, anti-gravitational propulsion, and non-conventional energy sources. He is a member of the Institute of Electrical and Electronics Engineers (IEEE), the Japan Society of Mechanical Engineers, and the Japan Society of Damping Technology.

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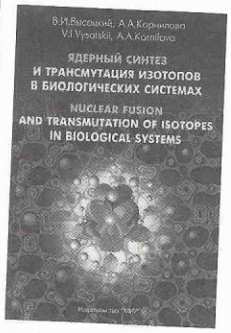

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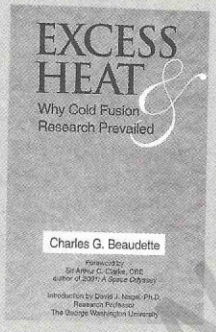

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Measurements of Light-Speed in Time-Shifted Reference Frames

Rockwell Haubrich

If large rockets are attached to an aircraft and mirrors are attached to the wingtips so the pilot can use light pulses and an accurate clock to monitor the distance out to each wingtip as the aircraft approaches the speed of light, time dilations will affect those measurements.[1] As the aircraft reaches relativistic speeds, less and less time will pass onboard the aircraft while each successive light pulse travels out to each wingtip and back, and since the wings on an aircraft could not contract perpendicular to the direction of motion, the pilot would have to conclude that those light pulses were traveling at faster and faster speeds.

For example, if the resting length of each wing of the aircraft is 30 meters, the time required for a light pulse to travel out to each wingtip and back would be about 200 nanoseconds while the aircraft was still on the ground, and the pilot would measure the speed of light of those pulses to be 60 meters divided by 200 ns or 3×10^8 m/sec. After takeoff, if this unrealistic aircraft increased its speed to 99% of light-speed, relativistic time dilation would slow the passage of time onboard the aircraft.[2] At that speed, if the pilot measured the time required for a light pulse to travel out to the wingtip and back to be only 28 ns, he would either have to conclude that the wings on the aircraft contracted perpendicular to the direction of motion (which would contradict the existing theory) or that the speed of light pulses increased to more than 21×10^8 m/sec—more than seven times the speed of light measured on the ground (the only other possible explanation).

This same problem of different observers measuring different speeds for a pulse of light could be confirmed using only existing, well-established technology by simply measuring the speed of a light pulse above 10,000 km, the altitude at which an equivalent (gravitational) change in the passage of time is known to be measurable.[3] The higher the elevation, the lower would be the gravitational field strength at that location, therefore the faster time would be passing at that location, the more time would pass during any measurement interval, and the slower would be the resulting speed measured for anything moving at that location.

If the speed of light will measure different values at different elevations, then there is no reason to believe it would measure the same value even on different floors of a single building if it were accurately measured; and the assumption that the speed of a light pulse will measure a single constant value for all observers,[4] even for all inertial observers, will need to be reconsidered.

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Comments on the Haubrich Paper

Thomas E. Phipps, Jr.

According to special relativity theory (SRT) Haubrich's conclusions are wrong, since they violate one of the postulates (light speed constancy) of the theory. However, it is instructive to seek what lies behind this. A critical step in his argument is: "As the aircraft reaches relativistic speeds, less and less time will pass onboard the aircraft while each successive light pulse travels out to each wingtip and back. . ." The problem here is that Haubrich has been deceived by claims that SRT tells us something about "time" in the abstract. If that were the case, then time dilation would describe an objective phenomenon, so that it would be correct to say, as he does, that "less and less" of this universal time commodity transpires between observable pulse travel events. But that is not what Einstein said. He said, in effect, that there exists no such universal commodity, and that each inertial observer has his own "time," related to that of other observers by an event calculus based on the Lorentz transformation. It is not true that less and less of the pilot's time (*i.e.*, of the time recorded by his clock) passes between light-pulse return events—according to SRT, it is more and more of the ground observer's time that passes (while correspondingly longer and longer slanted light-paths are traversed by the pulses). Consequently, the light speed measured by the pilot with his own clock remains invariant, as Einstein postulated; the same being true for the ground observer. That is, any "actual" change of light speed is unmeasurable or metaphysical. This fits with the relativity principle, which says that the pilot (when unaccelerated, and with view confined to his own aircraft system) does not know he is moving. If he could measure a change of light speed within that closed system, he would know.

From this it may be inferred that SRT supporters overextend themselves when they claim a fresh insight into the nature of physical time. They have merely re-parameterized "time" in such a way as to make their description of light compatible with an assumed validity of Maxwell's equations in every inertial system. Because Maxwell's equations contain only a single propagation-velocity parameter c, it is essential to this approach to treat c as invariant—not because of any objective aspect of the physics but because of a lack of electromagnetic descriptive parameters apart from

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the one. Since the number of descriptive parameters is at the describer's option, a strong suspicion arises that there is nothing unique about the Einstein approach. He chose a kinematics in which the multiplicity of parameterization is loaded onto "time". . .but he might conceivably have chosen to load it onto light speed, or some other aspect of the problem. Nevertheless, we have empirical evidence (from the CERN muons) that when work, either kinetic or gravitational, is done on a clock or other timekeeping device its rate is objectively slowed. Work is physics—a physical prerequisite—not kinematics. Any reconceptualization of the electromagnetic-kinematic problem closer to the physics must allow for that. It must be said that SRT "lucks out" in this matter, since it makes no reference to "work" and deliberately disconnects itself from any underlying physics. SRT does not dirty its skirts with physics—its loftiest aim and attainment being "self-consistency." To claim physical insights from SRT is thus oxymoronic. Those (mathematicians) who place themselves above physics through the crafting of axiomatic systems must abandon the claim to get more physics out than they put in—unless they would have us believe in magic.

Response to Phipps

Rockwell Haubrich

Dr. Phipps argues that the conclusions in this paper contradict relativity theory and the principle of relativity and I agree, but those conclusions are not based on any theory. They are based on replicated and confirmed empirical findings from the laboratory, the most important of which are cited in the paper.

He argues that the passage of time on the aircraft will not be affected by the motion of the aircraft, that time dilations are not a physical change in the passage of time, but that position contradicts and ignores all of the empirical evidence in this area, some of which is cited in the paper, and which has been replicated and confirmed and is undisputed in the laboratory.

Dr. Phipps then goes on to argue against people who support relativity theory, but I think we agree that my paper does not do that.

One very clear conclusion in this paper is that the speed of light measured on a platform above 10,000 km will have a lower value than it does when measured at sea level. That would be an easy prediction to test using existing technology, so that would be a less conjectural subject for this discussion. Is Dr. Phipps prepared to argue that those two measurements will have the same value? ❐❐❐

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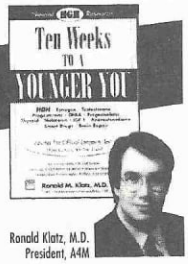

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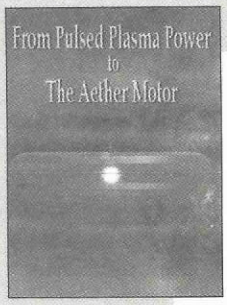

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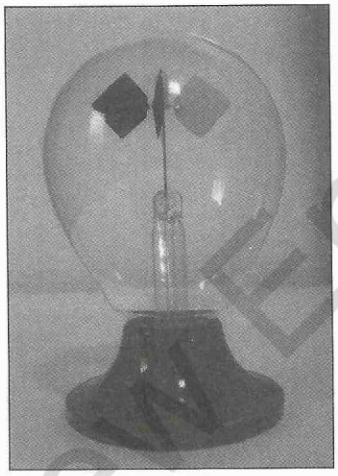

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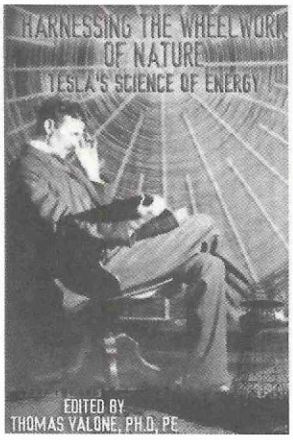

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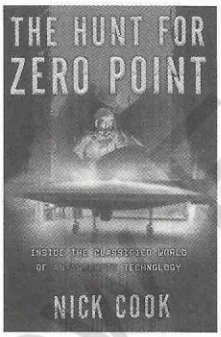

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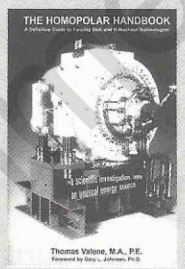

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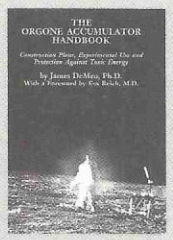

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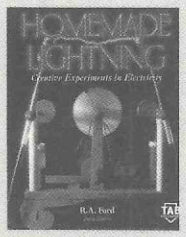

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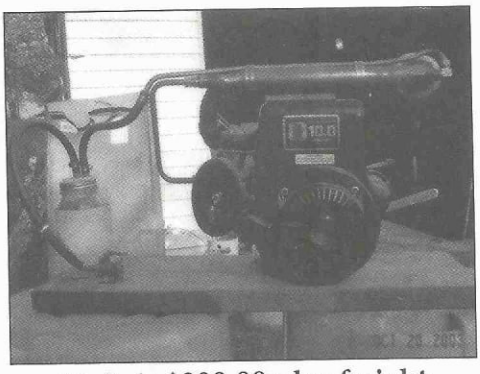

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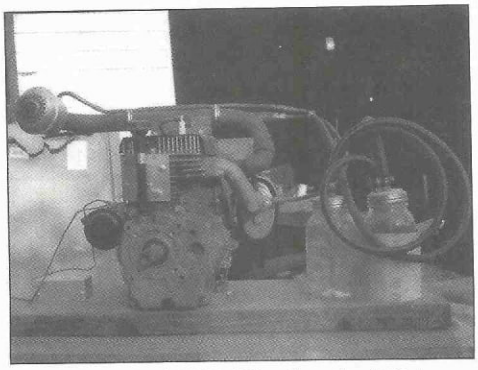

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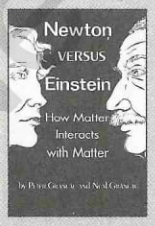

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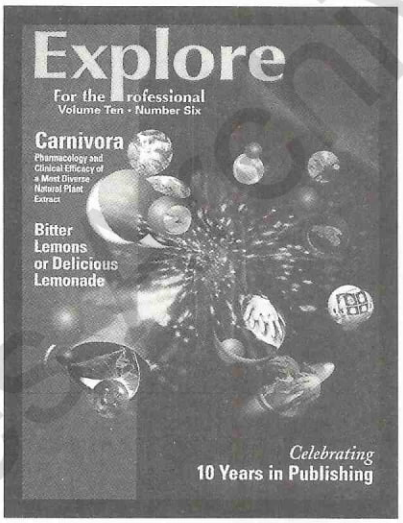

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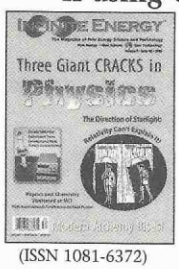

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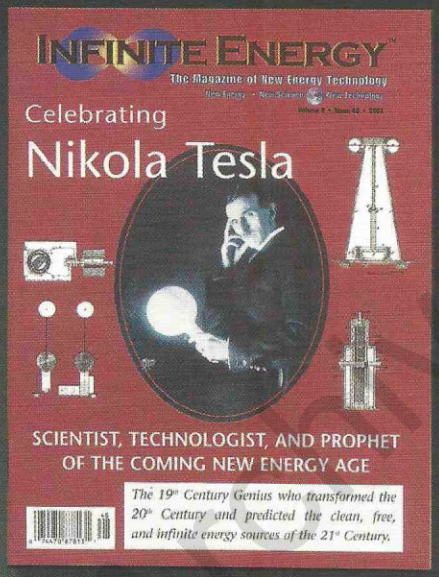

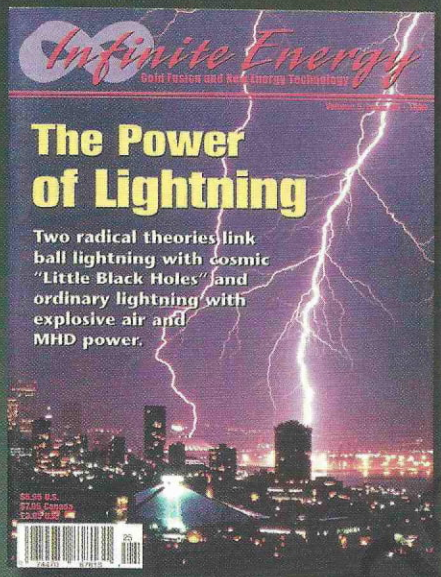

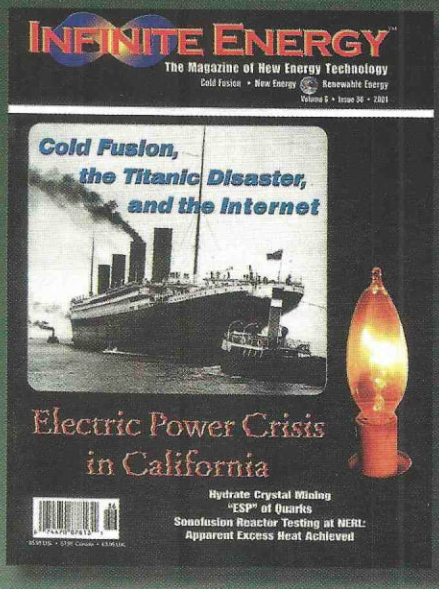

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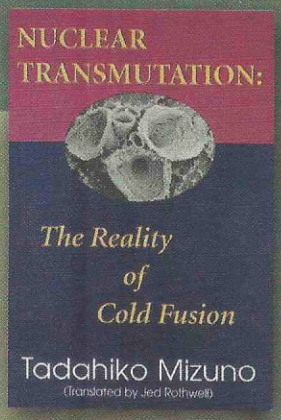

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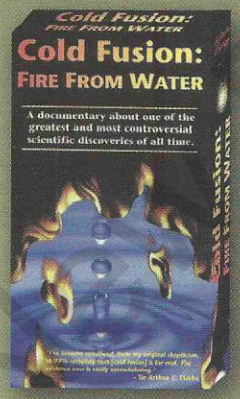

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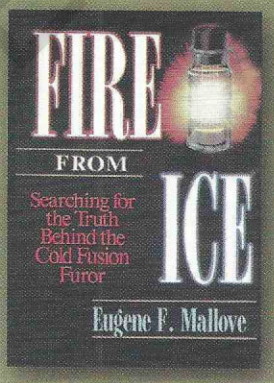

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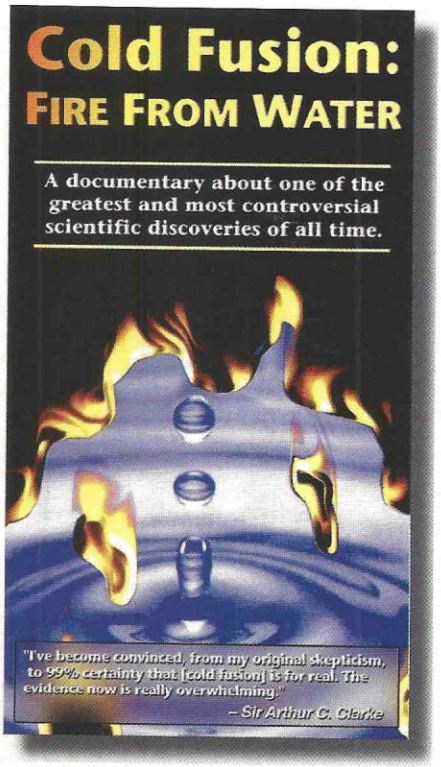

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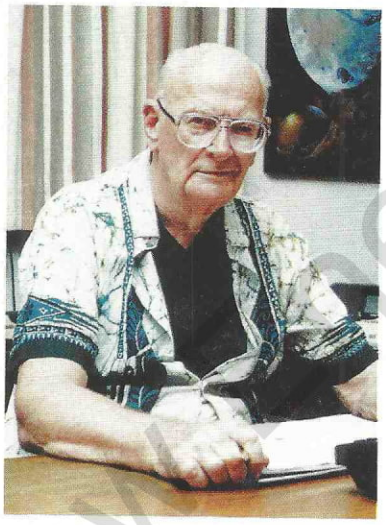

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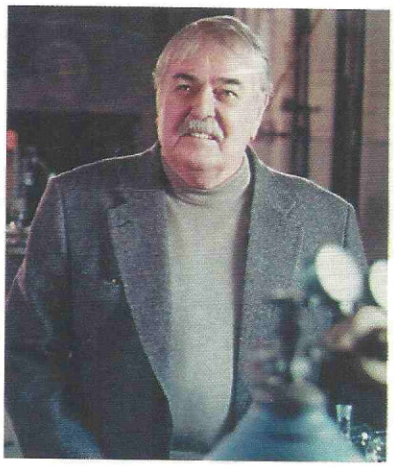

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